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A QUARTERLY MAGAZINE

OF

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EDITED BY

W SCHLICH, PH., D.,

CONSERVATOR OF FORESTS, BENGAL.

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INDIAN FORESTER.

Vol. I.] JULY, 1875. [No. 1

OUR PROLOGUE.

At the commencement of our undertaking, it behoves us to offer an explanation of the principles which will guide us, and the objects we shall have in view, if we are fortunate enough to gain the public approval, and be elected to represent forest literature in the estate of the Public Press of India.

Our object is to supply a medium for the intercommunication of ideas and the record of observations and experiments, as well as to catch all stray fragments of information, all *facts* and *data*, and supply the places of "Notes and Queries" to the Forest Service generally.

As to our principles, they are decidedly liberal and independent. We, and all who communicate with us, are free to express what we think; we shall not repress any criticism on what we honestly believe to be wrong, or say anything that we do not believe to be true, to please *any one*. We shall endeavour to extenuate nothing, and we shall "set down nought in malice."

But free, full, and unfettered discussion of every principle and practice is the very life of forest science and forest art.

That discussion it will be our endeavour to facilitate with all the means at our disposal. But this thing we will do—we will impress on ourselves and our contributors the absolute maintenance of courtesy and good temper in the thick of the hottest discussion, and we will banish from our pages every thing that verges on personality or harshness of expression. Our criticism will be directed to measures, not men, to the opinion and utterances of the impersonal office, not to the thoughts and deeds of individuals.

We are suppliants at the threshold of every temple of Government; we ask for assistance, for the speedy communication of

every report and every paper that deals with any thing of theoretical or practical interest in forestry, as well as of all orders that bear on the organization and interests of the Forest Service; but we confidently expect that no authority will desire in return for such assistance other than the gratitude which courtesy commands and a hearty endeavour on our part to support warmly, where support is due, without abandoning our right to criticize, where we cannot approve.

In pursuance of the general principles enumerated, we do not propose to open our columns to personal grievances; but questions affecting the organization of the service, or a section of the service, are legitimately within our scope. We propose to allow ourselves the option of declining papers which are unsuited for publication, or which are based on absolutely unscientific grounds; but we trust that the exercise of this discretion will rarely need to be called into action.

We have now earnestly to address our supporters in behalf of this new scheme of an Indian forest periodical. Above all we want steady contributors. Now many forest officers feel, and naturally so, that they have no time for writing. Others feel that they have no facility with the pen, and perhaps too modestly imagine that they can do nothing to help. With regard to this feeling, we would offer a few remarks. In the first place, while every number ought to contain a fair proportion of leisurely-written and detailed matter, that share of the work must necessarily be handed over to those who have a gift for writing, and who have the necessary literary machinery in the shape of books of reference to assist them. But the only value of a periodical of this sort will not consist in its containing elaborate essays. A large portion of it should be devoted to "Scraps" and to brief "Notes and Queries." Every forest officer who is worthy the name keeps a note-book, and as some new fact or some new experience comes to his notice, or some "happy thought," tending to the facilitation of some portion of his work, flashes across his mind, he will make a rough note of it. There is actually no one who can go about from day to day on plantation work, up and down a river on timber transport business, demarcating a forest, making valuation surveys, or engage in any other

branch of his ordinary business, but must see something, and learn something, which is in itself valuable, and a distinct addition to the stock of facts which are the basis of all rational and practical progress in forest administration.

And here is *the* line for the forest officer who loves not desk and blotting-paper. Send us in, then, rough and unartificial, from your note-book jottings. A diamond, even uncut, is a diamond still; and even if we cannot always have a diamond, we can have a crystal, and that is a very good thing in its way.

We beg every one to send what he has, and not to subject it to a preliminary criticism, and put it on one side. "I did not think you would care about it; I thought it hardly worth sending," are sentences that consign to inutility many really valuable facts, many good suggestions, that may contain the germs, perhaps as yet only partially developed, of future progress, or of some important economy.

Literary merit or excellence of style is not looked for in such communications.

Another way of helping may be indicated to those whose taste or the sterner call of duty forbids literary work—"ask questions." The interchange of opinions and expressions on all sorts of forest matters will be most useful, and it will create a good discussion, which will be of vital importance to our paper.

We shall endeavour ourselves to keep a good look out for information gleaned from home literature, as well as that of other countries, but we would invite every one to call our attention to articles or other sources of information of this kind, and to correspond with friends at home, with a view to keeping us informed of the progress of forest literature, furnishing us with notices of recently published books, stating the prices and class. Communications regarding the supply of forest material to public works, improvements to be made in transport, information regarding seasoning timber and impregnation, regarding buildings, hill roads, cheap bridges, and numerous other connected subjects, will doubtless enable the latter class to benefit the public with their experience.

So much is applicable to forest officers, but we hope that forest officers will not be our only contributors; the scope of

subjects open to comment will no doubt enable district, settlement, railway, and engineer officers to give occasional assistance. Procedure in settling forest rights, notices of forest tribes and their requirements, questions of organization, principles of settlement, &c., will furnish opportunities for the latter to help us.

We may add that we shall be able to illustrate papers by diagrams and drawings of a simple character, capable of being reproduced in octavo size, by lithography or by simple woodcutings.

As regards authorship of papers, every contributor is expected to communicate his name, and state whether he wishes the article, the question, or the note to be inserted with his name, or with his initials, or under a *nom de plume*, or without any name at all. Either plan can be adopted, provided that the real name and address of the writer be entrusted to the Editor.

Whenever possible, rejected MS. contributions will be returned to the author at his request.

The magazine will be arranged under headings in the following manner :—

I. Articles, translations, official papers communicated, &c.
II. Reviews.
III. Notes and queries.
IV. Shikar and travel.
V. Extracts from Official Gazettes, appointments, promotions, transfers, &c.

Circumstances may, of course, render a modification of this programme advisable or necessary.

It has been suggested that we should indicate the sort of subjects on which papers, notes, and queries may be communicated. With a view, therefore, of giving information to meet such enquiries, and not by any means to fetter the discretion of intending contributors, we offer the following sketch.

In the first instance we mention the subject of organization of service and forest law. Then sylviculture, as artificial reproduction, methods of working the soil, of sowing and planting, the rearing and treatment of seedlings, description of tools, natural re-production, methods of treatment, cultivation of minor forest produce, &c. Next come working-plans in all their bearings,

as forest surveys, methods of ascertaining the contents of growing materials, and of the rate of growth, methods of working forests or plans of operations. Utilization of forests forms another great section, as the properties of the different kinds of wood, the harvesting of forest produce, marking, girdling, and felling of timber and wood, tools, extraction of India-rubber, production of lac, fruits, as of Bassia latifolia, grass, leaves, peat, &c. Then again charcoal burning, preservation of forest produce, especially of wood and seeds, impregnation of the former, transport of forest produce by land and water, dragging, carrying, carting, snow-sledges, timber slides, floating and boating, and of all things road making. The different methods of the disposal of forest produce, sale of standing forest produce, working by Government agency, permits, private sale, and public auction. Next we mention protection of the forests and their produce against men and beasts, treatment and settlement of forest rights and privileges, area of forests, its maximum and minimum, forest boundaries and their demarcation, protection of humus, and other beneficial substances. Protection of forests against fires, storms, avalanches, frost, and of forest trees against diseases. Forest statistics and forest finance are two more great chapters. Then the physical and chemical properties of the soil, their influence upon forest vegetation, the atmosphere and its importance, heat, frost, moisture, light, winds, and storms. Effect of forests upon climate, inundations, landslips, &c.

The above subjects are those most intimately connected with forestry. But besides these there are many others to which our pages are open, as forest botany, geology, zoology, physical science and chemistry in their bearings upon forestry, national economy, agriculture, &c.

We shall further accept with thanks communications on camp life, travelling, sports, notes on forest tribes, their habits and customs.

These lists are far from exhaustive, but they are at least full enough to show that there will be very little difficulty in finding matter of interest to communicate.

The field is a wide one; let us try and occupy it successfully.

B. H. BADEN-POWELL.
W. SCHLICH.

J. ARTICLES, &c.

Remarks on the Sunderbuns,

By W. Schlich.

Most people in India, at one time or other, have heard of the Sunderbuns; and those who landed in this country at Calcutta are sure to remember the low islands forming the banks of the Hooghly. The forests on these islands supply Calcutta, and indeed the Twenty-four Pergunnahs generally, Jessore, Backergunj, and other districts with timber, fuel, thatching grass, &c., and the following notes may therefore be entitled to a place in this periodical.

The Ganges and Bramaputra, the great drainers of the central and eastern Himalayas, may be said to be the parents of the Sunderbuns. These two rivers, in carrying year after year large quantities of silt from the mountains to the plains, and thence on through the numerous branches of their combined delta to the Bay of Bengal, have in course of time formed the Sunderbuns, and indeed a great portion of the plain of Bengal itself. The action still continues, and consequently the formation goes on, though it may be almost inperceptible at the time. Owing to this mode of formation, the Sunderbuns show the lowest level near the sea-face, and they rise slowly towards the north. But there appears to be a second mode of rise, and that is from south-west towards north-east, so that a point 20 miles from the sea in the eastern portion would generally be of a higher level than a point 20 miles from the sea in the western part. Hence it comes that the highest parts of the Sunderbuns are found in the north-eastern corner, near Morellgunj, and the lowest in the south-west, that is to say between the mouths of the Mutlah and Hooghly rivers. The peculiarity here indicated in a general way is of the greatest importance with regard to the vegetation, as will be seen further on. The lower parts of the Sunderbuns are inundated at every flood-tide, fresh deposits are made, until they get by degrees beyond the reach of high water, except on the occasion of spring or other exceptionally high tides, when the whole of the present Sunderbuns is inundated. Barring these occasions, the north-eastern parts are from one to two feet above high-water mark.

The soil on the Sunderbun islands, being river deposit, is of a light nature, and consists as a rule of sand and loam mixed in different proportions, occasionally also with clay, and now covered with large quantities of vegetable mould. On the whole the soil must be very fertile; but owing to the inundations by salt water, it is adapted for certain kinds of vegetation only.

For many years past, as the formation of soil proceeded from north to south, and as the northern islands rose above high-water mark, cultivation seems to have proceeded in the same direction, and so we find now the northern parts of the Sunderbuns under cereals. But still a large area is uncultivated, and it is with this unleased portion that we have to do in the present instance.

The vegetation in the Sunderbuns comprises about 40 different species of trees and shrubs; of these the following three are the most characteristic :—

GORAN	... *Ceriops Roxburghiana.*
GANGWA	... *Excoecaria Agallocha*
SUNDER OR SINDRI	... *Heritiera littoralis.*

To these should be added two palms—

GOLPATTA	... *Phœnix paludosa.*
and HITAL	

It appears that new-formed islands, which are still inundated by every flood tide, become covered with a growth of *Goran*, alternating with strips and patches of *Hital* or *Golpatta*. As the level of the islands rises, other trees settle on them, and of these *Gangwa* is the most frequent. When the level is further raised, so that the islands are flooded occasionally only by salt-water, *Sunder* makes its appearance, and soon occupies the greater portion of the land. Thus we find the *Sunder* forests chiefly in the north-eastern portions, that is to say, on the highest lands, *Goran* along the sea-face and in the west, and *Gangwa* in the intermediate islands. It must not be understood, however, that the above general distribution is carried out strictly. *Sunder* appears vigorous and as a full-grown timber tree only in the north-east portion of the area, and it dies gradually away on proceeding to the south and west. *Goran* is most numerous in the lower lands, and it would probably grow just as well on the higher land, if it had not to give way to other trees. *Gangwa*

is most numerous in the intermediate compartments, but it spreads into the *Sunder* tracts on the one hand, and into the *Goran* tracts on the other.

Of the remaining trees the following are the more important:—

BAEN	... *Avicennia tomentosa.*
KIAURA	... *Sonneratia apetala.*
KOLSHA	... *Aegiceras corniculata.*
POSHUR	... *Carapa obovata.*
SHINGR	... *Cynometra bijuga.*
LATMI	... *Amoora cucullata.*

Sunder is of the first importance. It grows into a tree of up to 60 feet high, and of 6 feet girth, a larger circumference being rare. The heart wood is of a brownish red color, hard and very heavy, one cubic foot of green timber weighing as much as 104 pounds. It is used for a great variety of purposes, as beams, buggy-shafts, planking, posts, furniture, firewood, but chiefly for boat-building. Indeed, without this timber the boat traffic in Lower Bengal could never have reached the extent which it has now, and the permanent supply of this timber is, therefore, of the highest importance for the welfare of the Twenty-four Pergunnahs, Jessore, Backergunj, and the adjoining districts.

Gangwa grows to a height of 40 feet and a girth of 5 feet: its timber is white, and not very lasting; it is used for general carpentering purposes, for posts, and for firewood.

Goran reaches generally a height of 25 feet, sometimes up to 35 feet, but rarely more than 1 foot 6 inches girth. The wood is of a red color, and is extensively used for posts and for firewood; the bark is used for tanning.

Baen reaches a height of 60 feet, and gives a white heavy wood, very brittle, which is used for firewood only.

Kiaura grows 60 feet high, and its wood is of a light color, used for planking and firewood, but not much prized.

Kolsha reaches a height of 25 to 30 feet, and is used for firewood.

Poshur grows 45 feet high; its wood is used for building purposes, furniture, and firewood; it lasts fairly well.

Shingr, a small tree, up to 20 feet high, wood whitish, hard used as firewood.

Latmi grows up to 45 feet high; wood white, hard and heavy; used for building purposes and firewood.

Hital is cut for rafters, which are said to last up to 15 years.

Golpatta is used for thatching all over the districts adjoining the Sunderbuns; it is said to last up to 5 years.

Most of the remaining trees are made use of, but chiefly as firewood.

Throughout the Sunderbuns the growth of the vegetation is very vigorous, and where cutting has not cleared the ground, it is covered with a dense mass of vegetation. The trees also grow very fast, and the wood-cutters say that a full-grown Sunder tree is only some 20 to 25 years old. Although this statement is not to be relied on, still there can be no doubt that it is a short-lived tree, which is proved by immense numbers of dead trees, that have evidently died a natural death. It would appear that Sunder rarely attains an higher age than 50 years.

Reproduction is most favorable. On all lands flooded by ordinary flood tides a new growth of jungle springs up immediately, where the old material has been removed, as the seeds are carried on the lands by the water. And the same may be said of the lands above ordinary floods, provided a sufficient number of seed-bearing trees remains; but where the latter is not the case, as on extensive clearings, reproduction is very uncertain, and at any rate very slow. It has been put forward that reproduction all over the Sunderbuns is unlimited, and that cleared blocks will be covered again with forest in a very short time. This view does not hold good in the case of land above ordinary high-water mark, and consequently in the Sunder tracts. If such lands are once cleared, grass will spring up, and a growth of timber trees can only establish itself by very slow degrees, and after a very long lapse of time—a fact which is proved in several places in the north-eastern Sunderbuns. The cleared land, if left to itself, will have to take its chance of a few trees settling on it; but a general reproduction will not take place until such isolated settlers themselves begin to bear seed.

As one reason that reproduction is equal to the demand, it has been brought forward that large numbers of dead trees are observed over the Sunderbuns. But on examination it will be found

that the dead trees were all of inferior quality, either unsound or badly shaped, so that timber-cutters did not consider it paying to remove them.

The Sunderbuns yield year after year immense quantities of forest material for all adjoining districts, especially the Twenty-four Pergunnahs, Jessore, and Backergunj. Endless numbers of boats proceed in the dry weather to the forests, and return laden with timber, especially Sunder, rafters, firewood, thatching grass, &c., to supply which there is no other source available. And consequently it is our duty to see that the supply is not exhausted. Moreover, the demand is certain to increase, and we must therefore make sure that the increase also is provided for. It has been said that the supply is inexhaustible, but such is not the case. It appears, on the contrary, that the western part of the Sunderbuns, which is that nearest to Calcutta, is already exhausted to a very large extent, and that fuel-cutters proceed more to the east year after year. Even in the Sunder tracts, one sees for long distances from the rivers' banks nothing but dead Sunder trees and seedlings. No doubt the centre parts of the islands still contain large quantities of full-sized trees, but then it should be remembered that nearly all islands consist of marshy ground, and that all material has to be carried or dragged by men to the banks of rivers and nullahs, so that practically a great portion of the available stock must be considered as beyond reach. Moreover, owing to the absence of accessible and superior fuel in the western half of the islands, fuel-cutters resort more and more to the Sunder tracts in the east, and here they cut, not dry trees or the branches of trees felled for timber, *but saplings of Sunder* of good growth, which are easier to cut than dry wood, and which pack closely in the boats. Indeed, herein lies the great danger of the supply of Sunder timber for boat-building being exhausted. If the straightest and best saplings are cut for fuel year after year, and in the accessible parts of the forests, it is but natural that the supply of full-grown timber must fall short. This explains why the boat-builders in the Backergunj district, where boat-building is chiefly carried on, have complained for some years past that they cannot obtain now the same class of Sunder timber which they used to get in former years—a point to which

Sir Richard Temple drew attention in a note on the Sunderbuns, dated September 1874. In short, if the Sunderbuns remain open to all comers, and if certain restrictions are not introduced, there seems no doubt that the supply will fall short of the demand. This must be avoided, as no other sources of supply are available, and therefore the Sunderbuns should be taken under forest management without delay, instead of extending cultivation towards the south without considering to what extent the permanent yield of forest produce may be curtailed by it.

On Coomrie Cultivation,

By J. L. Laird.

The present system of coomrie, as practised in Bedi, consists in coppicing all unreserved trees on a given area, burning the leaves, branches, and other litter, and raising crops of grain by means of the manure thus obtained.

By the time two or three crops have been produced, the soil is exhausted, and the ryot finding further cultivation unprofitable, goes on to another field, which he treats in the same manner. In this way he proceeds from field to field until the scrub on the first has reproduced itself in sufficient quantity to give, when burnt, one or more crops of grain. The latter is then again cultivated, and the same process as the preceding repeated over and over again as long as the soil produces enough scrub for a *khuski* crop.

In practice coomrie is not carried on quite so regularly as might be inferred from the foregoing remarks, which shew how it would work if performed more methodically.

The best kind of land treated as coomrie requires two or three years' rest to recover sufficiently to yield another crop; so that the best soils may be said to be fallow, or unproductive—a very small revenue from reserved trees excepted—at least every other year, and inferior soils for longer periods.

It is, I think, a generally admitted fact that the fertility of land diminishes more or less rapidly under coomrie, and the object of this paper is to propose the adoption of a method of treatment, under which the deterioration of the soil might be

greatly diminished, or, under favourable circumstances, entirely arrested, and a fair rent realized at the same time.

Shortness of the revolution (which precludes all possibility of the soils recovering in the intervals of rest), and the absence of any attempt to regenerate or protect suitable kinds of trees by artificial means, appear to be radical defects of the present system.

I propose, therefore, to lengthen the revolution sufficiently, if possible, to admit of the trees attaining timber size; to protect and organize the forest; and to regulate coomrie.

I think it would be well to let the trees grow up to maturity (say 30 to 50 years, or more) whenever practicable, not only for the sake of increasing the revenue, but also in order to give the soil ample time to recover and improve. At the same time I do not see why the plan about to be proposed should not succeed with forests having a revolution (rotation) of less than 30 years—say as low as 15—but then the forest would have to be coppiced, and for obvious reasons coppice with short revolutions would be less desirable than seed woods with longer revolutions.

According to this plan the forest would be divided into compartments of equal area, their number and size, as well as the length of the revolution, depending on the area required yearly for coomrie. These compartments would be cleared of timber in regular succession by the method of 'clean cuts.' After clearing a compartment, the land would be given over for two years agriculture to the ryot, who, by preparing the ground for his own purposes, would, at the same time, thoroughly prepare it for the next forest crop. In consideration of the labour he would have in digging up roots and stumps (which he would be allowed to burn for manure), and otherwise preparing the ground for cereals, and on condition of his planting out a certain number of seedlings per acre at the end of the two years, the land might, perhaps, be given free of rent.

To make my meaning clear, let us take a forest of which one acre is required yearly for coomrie, and the revolution fixed at 20 years. Then it is evident that, if the trees in each coomrie compartment are to reach an age of 20 years, we must reserve 20 acres for the purpose. These 20 acres, having been selected and marked off, would then be divided into compartments of one acre each

and worked in regular succession, one every year, so that by the time the 20th cutting had been carried out, the first would be stocked with trees 19 years' old, and ready for the axe the following year. In this example the yearly cutting is confined to one spot; but of course this is not necessary; all that is required being, that the cuttings during one year, taken together, cover an area of one acre. I have also assumed, for the sake of shortness, that the ground is used for agriculture only one year, and that the forest is regenerated simultaneously with the sowing of agricultural seed. If the land were used for agriculture during two years, the area required would be about half (see note).

I think that, by somewhat lengthening the revolution, by carefully selecting the kind of tree, and by close planting, so as to get an unbroken cover as soon as possible, a good revenue might be derived, and the wants of the people satisfied at the same time. If we compare the long revolution during which the soil would be improving, with the short period during which it would be more or less deteriorating under agriculture, there is good reason to hope that the land would thoroughly recover before the end of the revolution, when it would again be used for agricultural purposes.

The only objection that can, as far as I am aware, be brought to bear against the method is, that to carry it out might perhaps require a greater area than would always be convenient; but the area required is not so great as might appear at first sight, and the length of the revolution would be regulated with due regard to the extent of country available, coppice being resorted to when the revolution had to be greatly curtailed. A village demanding 40 acres of coomrie yearly would require, for instance, for a revolution of 50 years, 1,040 acres altogether; but for a revolution of 20 years only 440 acres.

It must be remembered, too, that in coomrie districts the population is scanty, and the land under cultivation but a small fraction of the whole.*

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* By 'coomrie districts' I mean those in which the capital available for cultivating the soil is so small, the waste land so extensive, and the people so poor, that Government think it necessary to allow coomrie.

The fact of land having once been coomried is in itself no criterion that the land is now absolutely coomrie land; indeed, if it were, all tracts now under cultivation would constitute coomrie districts.

I have taken at random six of a number of villages, the forests of which I inspected this year. The people are generally poor, although, perhaps, nowhere absolutely in want. The following table shows the lands of each village under "khuski," "tari," forest.*

VILLAGE.	Population.	LANDS UNDER					
		KHUSKI.		TARI.		FOREST.	
		Acres.	Guntas.	Acres.	Guntas.	Acres.	Guntas.
Kúmbhándé ...	254	115	38	23	5	2,961	19
Kúmratseádi ...	?	112	27	82	32	832	6
Degegháli	192	45	38	63	14	685	4
Mumdwád Pimple ...	192	44	18	351	6	1,203	13
Somset	?	...	...	28	32	133	25
Mácháli	76	28	7	172	18	394	14
Total ...		347	6	731	27	6,209	21
Average for one village ...		Acres. 58				Acres. 1,035	

As coomrie-land is essentially khushki-land, it is not necessary, in examining the coomrie resources of a forest, to take into consideration demand for rice-land.

Supposing, therefore, the whole of the above forests could be coomried (they have already been coomried throughout), and that a revolution of 60 years is decided upon, then 36 acres could be given over yearly for coomrie; in other words, the ryots would have the opportunity of bringing under cultivation, besides waste lands, 62 per cent. more land then they now have under khuski crop. But, supposing it were thought advisable to allow only the better parts to be coomried, and that these amounted to

* *Khuski* land can only produce a 'dry' crop (*i.e.*, grain which does not require much moisture, such as wheat). The more valuable, *tari*, or 'wet,' land is suited to the growth of semi-aquatic plants, such as rice and sugarcane. The former generally corresponds to the *aek fasli* and the latter to the *dó* and *tin fasli* lands of Hindustan.

75 per cent. of the whole, then—for the same revolution as before—there would be 27 acres available yearly, or 46 per cent. more than the present area under khuski crop.

Besides the lands given in the table, there are in these 6 villages altogether 560 acres of waste land: this area gives 93 acres for each village, or nearly double of that now under khuski cultivation.

It appears, then, that in part of the Bídi táluk, at all events, this plan might succeed; at any rate, the forest area is sufficiently extensive.

It will be readily admitted that the maintenance of standards after the chief forest crop has been removed cannot fail to result in a diminution of the yield of grain—a diminution which cannot be measured simply by the quantity of nutriment absorbed by the standards, for the injurious effects of overshadowing must also be taken into account. By adopting the method of 'clean cuts,' this competition between forest and field would cease.

In the poorer parts of Belgaum and other countries this system has been in existence many years, and, I believe, found to answer the double purpose of providing a steady revenue for Government, and a means of subsistence for the people.

The following appear to be the more salient advantages of the method over the present one:—

1.—The soil would, at all events, deteriorate less, and most likely improve.

2.—Deterioration being arrested, a steady revenue be derived from the forest after the first revolution.

3.—The half measure of growing grain under standards might be avoided.

4.—The working of the forest would afford employment to the people.

In conclusion, I would remark, in order to avoid misapprehension, that I do not suppose this plan could be applied everywhere. For instance, in some coomrie districts on the ghâts the forests have been entirely exterminated, I am told, and there remains little or nothing but bare rock; of course no system of coomrie could restore the forests in such places.

Nor do I imagine that the system could always be carried out in its entirety. For instance, it might often be a dangerous experiment to dig up the roots in sloping soils for fear of the latter's being washed away during the monsoon. What I insist upon generally is, the necessity of lengthening the revolution and of protecting and managing the forests with the same care as would be bestowed on them, if they were never coomried; the rest is merely a matter of detail.

NOTE.—If the area of a forest (A) is divided by the length of the revolution (r), it is evident that the quotient gives the area of the annual cutting for a sustained yield (c), or $c = \frac{A}{r}$; but if each cutting is to lie fallow a number of years (n), the yearly cutting will be:

$c = \frac{A - nc}{r} = \frac{A}{r + n}$ and $A = c\,(r + n)$.

Example.—A village requires 40 acres of coomrie yearly, when $r = 50$ and $n = 2$. Find the total area required.

Here the average *yearly* cutting would be 20 acres. (For the first year 40 acres would be cut, second year nothing, third 40, fourth nothing, and so on—average 20.) $A = 20\ (50 + 2) = 1{,}040$ acres.

As n would always be very small—never in fact more than 2 or 3—in practise it might be entirely neglected. For instance, it would matter very little if, in the above example, the trees were cut at an age of 48 years instead of 50.

The means of obtaining length of Stem for Timber,

BY A. PENGELLY, M. A.

These means are two in number; 1*st*, the maintenance of the trees in a forest so close together as to kill the lower branches when still small from want of light; and 2*nd*, pruning.

We will first consider the latter method, more especially as it is what seems to suggest itself to most minds on first paying any attention to the subject.

Pruning, when performed on forest trees, should be done in the following manner: The branch should be cut off close to the trunk or to the branch from which it springs, and from below

upwards, not from above downwards. Also the surface left should be smooth and cleanly cut, so as not to allow of the lodgment of water.

We will now consider the reasons of these rules, which it is of the utmost importance to observe when pruning has to be performed

On considering the manner in which a wound on a tree heals, we observe that successive layers of wood are deposited by the descending sap, until at length the wound is covered over by the new sound wood formed on it.

Now, as long as the wound is exposed to atmospheric influences, it is liable to decay from the infiltration of water, &c. It follows, then, that we ought, when cutting off a branch, to cut in such a manner that the wound may be healed over as soon as possible.

That this is effected by cutting off the branch close to the trunk will be seen on very slight consideration; for suppose on the contrary that a branch be cut off at a distance, say of 4 inches, from the stem of the tree, the crude sap from the roots rises up to the leaves, where it is perfected, and descending deposits a new layer of wood. Now the sap in its descent follows mainly the law of gravity, and therefore the stump of branch left, being deprived of the leaves that were formerly above it on the branch, and being out of the line of the descending sap from other branches, receives no fresh layer of wood, or at the best only a very small one. Meanwhile, atmospheric influences act on the stump, and frequently decay sets in, which is often communicated to the heart of the tree.

At the same time the trunk goes on growing, and an annual layer of wood goes on forming all round the stump, which remains a piece of dead (not necessarily decayed) wood enveloped in sound growing wood, exactly after the manner of a nail. This continues until either the stump having become quite rotten drops off, leaving a hole to be grown over by sound wood, or else it persists until the growth of the tree quite envelopes it. On making a section through this part, the manner of growth can at once be seen, the stump of the branch shewing quite plainly from the surrounding portions, with which it has no connection. If, on the other hand, the branch is cut off close to

the trunk, the wound, *being in the line of the descending sap,* receives a deposit of wood every year all round its contour, and thus the exposed portion yearly diminishes until it is covered over. The wound is of course larger when this method is employed, but it is under the very best condition for healing: whereas, if the branch is cut off at a distance from the trunk, although the wound is smaller, there is little chance of its being healed, from the fact that it is out of the line of the descending sap, which is the healing power.

The precaution to be observed of cutting from below upwards is enjoined from the fact that, by cutting in the opposite direction, it commonly happens that the branch breaks off at last, carrying with it a portion of bark and wood, creating a larger wound, and one which, from not being smooth, is more likely to occasion the infiltration of water. These bad consequences are obviated by observing the above precaution.*

In order to leave a smooth surface, it is well to employ a sharp cutting instrument, not a saw; or if a saw is employed, to cut the surface over afterwards with a knife. With the same object, *viz.*, the protection of the exposed surface from atmospheric influences, it should be covered over, and for this purpose perhaps coal-tar answers best, as it is easily applied, and is very effectual in preventing decay.

In the Paris Exhibition of 1867, a very instructive series of the effects of bad and good pruning was exhibited by M. Mathieu, the learned professor of Natural History at the Ecole Forestière. In the examples of bad pruning a section made through the middle of the branch shewed frequently how, not only was a faulty piece of wood enveloped in sound timber, but also how the stump of the branch left had served as a canal to convey rottenness into the heart of the tree, and thus spoil the growth of years. Even when the operation had been skilfully performed, there always remained a clear solution of continuity (generally represented by a line of darker colour than the rest of the wood), shewing how the successive yearly growths had approached nearer and nearer to each other on the cut surface, until they met in or near the centre.

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* *Remark.*—A more practical method is to cut first a little from below, and then from above, so that both cuts meet.—THE EDITOR.

The oak suffers perhaps more than any other tree from the lopping of its branches, which is almost certain, unless very skilfully performed, to render it hollow. All the oak trees (*Quercus incana*) in the Panee Khet Forests have been constantly lopped by the villagers, in order to procure wood for their ploughs. The consequence is, that there probably is not a sound oak of any size in the whole of these forests, and I doubt not that the same would apply to the oak forests of other localities.

From the above it will be seen that, if we undertake to prune our forests, we must train men especially for it, and not entrust this important operation to the first comer. This is evidently a very serious objection, especially in India. Moreover, the area of our Indian forests is so large as to render it extremely doubtful whether this plan is practicable.

We shall do well, therefore, to consider whether pruning is necessary, or whether it cannot be dispensed with altogether.

Now, branches cannot live without leaves, and leaves cannot live without a sufficient quantity of light, the necessary quantity varying with the different species of tree. It is therefore worth considering, whether by keeping our trees thick enough together we cannot kill off the lower branches while they are still small, and when their disappearance will leave scarcely a scar behind. If we can do this we shall evidently obtain a tall and clean stem, and without a fault in the timber. Moreover, here the control remains with a forest officer and not with a subordinate, whereas it is impossible that the forest officer should himself prune every tree, or even be there to superintend its pruning. He could however on the other system designate what trees might be removed in the thinnings, so as to allow of the proper growth of the remaining trees without endangering the "natural pruning" by the admission of such a quantity of light, as to cause the persistence of lower branches.

Now, it is found in practice that this method can be carried out most successfully, though not always *in perfection*, by *merely* keeping the trees close together, for the shade given by some species of trees is not sufficient to kill off their lower branches. The oak (*Quercus pedunculata* and *robur*) is a case in point. In a forest composed solely of oaks, although by growing them thickly

together the length of stem would no doubt be improved, yet oaks grown in this manner cannot be compared for length of stem (which means quantity of serviceable timber) and straightness of fibre with oaks which have been reared in a forest mixed with beech or with hornbeam, both of which have a dense shade. I have seen oaks (*Quercus pedunculata* and *robur*) reared in this manner *without pruning*, which had stems at least 60 feet high without a branch, the whole of sound wood of first class quality, and 4 feet or more in diameter. I imagine that most people will allow that it is not usual to see either (*Quercus pedunculata* or *robur*) reared on other principles than the foregoing, and without pruning having a stem of more than thirty feet without a branch. It seems to me, therefore, that a system which can point to such results is one which we may safely adopt, especially when we consider that it is free from the danger of bad execution, which is almost inseparable from pruning, and that moreover it is much more easily applied to large areas, such as we have to deal with in India.

Of course in the case of isolated trees or in mixed coppice, where the standards are periodically left with their stems exposed, it will always be necessary to have recourse to pruning, and if the precautions recommended above are attended to, good results will probably be obtained; but in my opinion pruning should not be resorted to, even for plantations, where either the species of tree planted has a sufficiently dense shade, or where a sufficient shade can be obtained by the admixture of some other tree.

Pruning badly performed is worse than useless, and even when well performed it is inferior in its results to, and more difficult of application than, the other method here advocated.

Note on the Dehra Doon.

By B. H. Baden-Powell,
Officiating Inspector-General of Forests.

On my way down to Calcutta, I visited Dehra Doon for the purpose of seeing Captain Bailey. Having only a few days to spare, I could not, as I should have liked to, make a regular tour through these interesting forests, but I went out to the Luchee-wala sâl forests (Nagsidh hill and spurs) and through the Luchee-wala forest and up into the Bulawalah forests (sâl) on the north

slope of the Siwaliks. Afterwards I went through some of the lower forests between the Siwaliks and the Himalaya, and returned to Dehra. I visited afterwards a forest above Shorepoke with a view to getting on a height and seeing the general appearance of the Siwaliks. The Lucheewála forest exhibits a still dense forest of sâl. Here and there stumps of large size and trees of considerable girth showed that formerly timber of good size was produced on the ground now occupied by tall thin trees from 18 inches and under to 4 feet in girth. The feature of the forest is dense and uniform growth of trees with an under-growth of not very dense grass, very numerous seedlings of sâl, and in many places seedlings of a leguminous creeper (name unknown). Many of the trees also suffered from this creeper, the tall slender trees being weighed down, and the stems cut into by the pressure of the coiling stems. The maljam creeper (*Bauhinia sp.*) also covered many trees with a similar effect.

In the Lucheewála forest the trees generally exhibited a twisted or rather crooked stem covered with numerous knots and swellings, from which multitudes of small sprouts sprang. At the base, the stem always exhibited an unhealthy swelling.

All the stumps and larger trees were distorted and hollow from fire. The *Xylocopus* attacks dead but not living sâl. Occasionally one comes upon grassy tracts of greater or less extent in the midst of the sâl forest. These may be due to depressions in which water collects, and in that case they are full of a reedy, sedgy kind of grass, and we do not expect them to fill up with sâl trees, such blanks could only be filled by willow cuttings were it important to fill them; but it is not; the area of sâl is abundant, and such small blanks may be disregarded. Other blanks are on level ground, apparently of the same soil and quality as the rest of the forest. These are perhaps due to old and abandoned cultivation, and indeed the name of one of these blanks which I examined in Lucheewála Jabrkhet seems to lend support to the view. The effect of protection is, that the sâl seedlings are growing up under the edge of the forest, and filling up the blanks: even towards the centre a careful search shows a few seedlings of sâl and some of other trees. The grass is not as a rule dense; the "neel" and "moong" grasses (*Imperuta* and *Sacha-*

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ran spp.), which grow from dense tufts or masses, do not appear, and the grass is of such an "open and divided" character, that you can see the soil through, and therefore it presents no serious obstacle to natural seedlings coming up through it, or when necessary, seed *dibbled* in coming up in the same way.

I examined the soil in the Jabrkhet, and found it a rich colored brown loam, with a tendency to be stiff on the surface if exposed, and capable of producing with the aid of dead leaves and *humus* of the protected forest a very rich and valuable forest soil. No boulders appear, and I have no reason to doubt by the aid of what ravines and cuttings show that there is a good, though probably variable depth of soil over the boulder and drift strata below. The soil inside the forest was similar, and it was quite cool and moist at a depth of 2 feet.

The sál developes a long and thick tap root, which remains to a considerable age. Even a year old seedling had a very strong root, and a seedling, about 2 feet high, which proved on clogging to have been a shoot from a small stock (4 or 5 years old burnt down yearly), had a tap root 2 inches in girth at the top and only gradually diminishing when I stopped digging at 2 feet down.

It is incredible how any one who has seen such a forest as Lucheewála can have the least doubt as to the frightful injury caused by fires, which not only prevent any thing like timber growth, but will, if unchecked, slowly, but still quicker than people think, exterminate the Shorea altogether.

In Lucheewála I think there are not 30 per cent. of trees which are not hopelessly injured for *timber* growth by the fire, or creepers, or both.

There is a small tract (350 acres) partly in Lucheewála and partly in Bulawalah preserved now for 2 years from fire. This time is hardly long enough to show so marked a change that any one would perceive it, but it must be admitted that there is a difference already, and it will become more perceptible every year.

The peculiar shape of the sal seed (like a shuttlecock) enables it to fall at some distance from the trees (it germinates almost before it falls), but its weight and size does not allow it to go very far.

Bulawalah has much better growth, less creepers, a larger percentage of small and comparatively uninjured clean straight stems, and altogether a better class of forest on the north slope of the Siwalik itself.

Now, in making any general proposals regarding the treatment of these forests, I wish to guard myself against being thought to jump empirically at conclusions from one day's wandering through a class of forests; but I am told that they represent very much the style of all the Siwalik forest—some being worse, and Bulawalah representing a fair sample of the *good* forest.

I may here remark that the Doon presents easy features for forest organization. It is a tract of undulating ground; alluvial soil over boulders and drift between the Hymalayan Ranges and the Siwalik. The Siwalik extends in a compact range, the northern side covered with sâl, which is rather dense about the middle and lower portions, and thinner towards the crest. On the south side are abrupt scarped sandstone faces, on the ledges and flatter portions of which Babba grass (*Eriophorum*) abounds, and mixed forest of various deciduous trees scanty and sparse.

In the Doon itself, besides the Siwalik, there are more or less detached hills and level forest patches. Such are Nag, Sidh, Ambari, &c. I have here sâl like the Siwalik.

The Doon is divided into Eastern and Western portions by the road from Saharunpore to Dehra, &c.

Below the Siwalik, on the north side, we come to Savannah forest, broken ground generally with boulders and pebbles, but still with much soil in places, covered with long grass and scattered trees of *Rottlera*, *Bombax*, *Adhwari*, *Acacia Elata*, *Ficus Glomerata*, and many others.

In the Eastern Doon, with the exception of certain grants, there is little cultivation, and we may describe the forest right across to the Himalaya. After the Savannah forest we come to the streams, on the banks of which we find khair (*Acacia Catechu*) and sisu, sometimes in pure forests tracts, while in other places, where there are numerous side channels and streams wandering about, we have dense grass, and often streams in deep shade, where luxuriant belts of trees of glossy foliage, mostly unknown to me, are crowded together, and the beautiful creeping

rattan (*Calamus sp.*) may be seen. About here also toon trees flourish; this extends right across, till sâl is again reached, and then the lower slopes of the Himalaya, which do not belong to us (except a small leased tract, in which some *sein* (*Pentaptera*) grows). In the Western Doon, the whole of the area beyond and indeed including the Savannah forest is either cultivated and is private property, so that generally speaking the forest boundary ends with the actual sâl forest at the foot of the Siwalik or of the semi-detatched sâl bearing hills.

It is reasonably supposed that the same class of lands in the Eastern Doon will also be granted out and cultivated.

As far, therefore, as the administration of the forests goes, there should be two "executive charges"—the Eastern and Western,—and the whole under one "controlling" or divisional charge.

There are no rights, properly so called, in the forests, so that it will be proper (subject to some arrangements to be noted presently) to make the forest area consist of the Siwalik and detached sâl forests, and for the rest I would not propose to include anything else but a few plots, not too small, say not less than 1,000 acres of just the best "khair" and "sisu" forests before spoken of, and especially those where "toon" is found or could be encouraged. The management of the southern slopes of Siwalik would be simple; their position is their safety; but it is important to protect the growth, for the sandstone is very soft, and contains nodules and masses of more indurated stone, and also belts of boulders and pebbles. The more it is denuded the more these will be washed down to the great damage of such works as the Mohan Pass road and bridges. I would simply prohibit, as far as possible, *all cutting*, only allowing individual trees to be rarely and occasionally taken for purely local needs.

Passing over the sâl on the north slopes (for the moment), the limited areas bearing "sisu," "khair," or toon only require *protecting*. If such small areas can be kept clear of fire, I have no doubt that they would become valuable; with fire they will never become better, but gradually worse than they are now. When leisure is found it will be easy by cutting out other growth near the toon to encourage its natural growth, and to dibble in seed.

Now for the sâl: these will require nothing but *protection* and creeper cutting. From therein fire MUST ABSOLUTELY be kept out and GRAZING. The latter for two reasons, because the seedlings will not grow up without losing their top shoots, getting trodden down, &c., &c., but above all because where there is grazing there is *fire*.

But if the Savannah forest, &c., is given up in the Eastern Doon, as it is in the Western, there will gradually be but little ground left for grazing It will, therefore, be necessary to have certain blocks of the sâl forests—*not* taken out of forest charge, but left open to grazing, and as this forest is naturally divided for us into blocks by broad strong courses of torrents, &c., known as "raos," certain blocks between two "raos" may be left as open blocks for grazing only when local convenience prescribes.

As regards the idea that all the sâl forest may be opened to grazing, it is simply monstrous. If it is continued, it is a mere waste to spend money on surveys, working schemes, or officers; we may merely abandon the thing to the destruction which is inevitable, and leave it to yield what money it can (just as it did in old days) till it can yield no more. In short, the grazing must be disposed of in a rational manner, on a real enquiry as to the number of villages, houses, &c., to be provided for, and if possible the number of cattle to be fed; and not, in general terms, without reservation or control.

Next then I have to consider what sort of a working scheme will be required, again repeating that my ideas refer to what I have seen, and must be considered by those familiar with the whole place, and modified as may be necessary.

For the "south face forests" no plan is needed: it is simply necessary to protect, as I already said. The place should be divided out into business-like and manageable *administrative* divisions, so that the forest guards and foresters may have their own proper 'ranges' and beats.

In the sâl forests the blocks will mostly be made by the "raos" or artificial broad lines, and these will be divided into compartments.

Ordinary compartments are dependent on the natural difference of growth, soil, young forest, or old forest, &c.; but here it seems

to me that the whole of the sál is so similar as regards the features of treatment, that with the exception of constituting the grassy blanks (when of extent not less than 30 acres) as separate compartments, nearly all the rest may be divided into equal compartments.

The compartments need not *all* be fire traced, nor need they, I think, be very small; 200 acres would be suitable.

The reason for this explains also why I think that there is no need of a *valuation survey* at present.

It is that I regard the whole of the standing stock as one that will not, except a limited percentage of it, come to much, and it is to be regarded as a cover for the soil and to shed seed; it is to the young seedling crop that I look to make the forest; when that is well up all-over, then all the present bad trees will be cut out as improvement cuttings, without regard to age, size, and cubic contents.

When the ground *is* covered with the new crop uniformly and fairly, and this is no improbable speculation, but almost a certainty *if fire* is excluded, it will be time to make a valuation survey for the purpose of showing us how many good and improving trees of the former stock we actually have, and how the young growth will come on for cutting, at different periods, so as to obviate the difficulty of having all our compartments of the same age and class.

With a view, however, to amassing the information for such a future proceeding, and for other purposes also, it is, in my opinion, essential to have, as suggested by Captain Bailey, numerous "Sample areas" of 10—20 acres in different parts of the forest, and as far as possible under different conditions; these must be carefully fenced, and perhaps the *aloe*, so common in the Doon, would be planted as an additional probation, and as an immediate and visible indication of the plot. It is worth at least a trial.

Valuation surveys of the areas should be taken at once, and yearly measurements with notes of selected trees of various sizes.

It will be a good thing to have some good ring-counting made of sections cut from trees now standing.

The actual treatment for compartments can be simply prescribed.

First is to keep out fire. Now from the positive evidence we have that the forests have produced big sâl trees of great value and may do so again, I think it justifiable in the highest degree to spend a good deal of money in thoroughly and efficiently cutting broad fire lines. The smaller the sub-division, the more easy it is to prevent fire, or to stop fire once begun from spreading, especially when a well-ordered establishment has charge of the places, rendered to some extent more accessible by the cleared lines,* supposing them to be kept but clear; but here arises a difficulty; how far can we sub-divide the area by fire lines? Not each compartment, for we should have to make and to keep up lines in miles by thousands; but we must do it to some extent, say to protect blocks of 2,000 acres at the outside as minimum of sub-division; and I believe that it will pay well to spend a good sum of money in making and keeping up the lines.

If we spend 10 to 15 thousand rupees a year, I would not object.

It is a pity not to take all the sâl we have, and it is *impossible simply*, as we are all agreed about that, to improve it on any other terms.

Then from the rest, we have at present not to cut a stick. Sâl comes up under quite thick shade, and directly you let in light, you have grass, and when grass is dense, seedlings do not come up, and you have the expense of artificially aiding the reproduction.

Whenever the ground is perfectly stocked, then carefully and gradually take out the bad poles of the present growth for sale: but at *present all the forest* is thin *enough* and *often more than thin* enough to allow of free germination, indeed, much of it is stocked already.

Also the plan will arrange that compartment by compartment *creepers are* to be thoroughly cut. This is essential.

In the blanks already described, I do not advocate nurseries or planting if protected by fire, as I have shown, all round the edges the reproduction is sufficient; just in the centre it may be necessary, I think, without *any* clearing of the grass or very slight in the worst places, to dibble in seed close together about the place. This

* I have here to make a suggestion. I find the patrols or guards do not go into the forest; they fear wild beasts, &c.; nor will they in Burmah. This is got over by fixing a forester's "range," but not the beat, simply giving a forester with one, two, or three guards under him, so that two or three may patrol together.

will certainly almost raise a lot of seedlings, and then after a year or more's experience, it will be easily seen whether just the centre formation will need to be either left alone, or out of desire for workman-like finish be planted up or sown a little more elaborately. That is all the plan that I think is wanted, but the order of cutting creepers and planting, &c., by compartments, will be laid down, to secure a fair apportionment of the work over several years, progressing from area to area.

In the khair and sisu forest, there is to be very little, or better no cutting for several years. I do not like the system of letting people pick out all the best khair stems for sugarcane rollers, &c.; and if they cut them, the permit should compel them to leave the *stump* close to the ground, but not *dug* out or hollowed, and clean to coppice. Where toon grows, I would encourage it by cutting away the other trees and weeds, and loosing the soil near the parent tree just when the seed is almost ripe; it will fall and spring up of itself. Further steps it is here unnecessary to indicate.

Mysore Sandalwood.

The following extract of a letter from the Conservator of Mysore Forests, to the Secretary to the Chief Commissioner of Mysore and Coorg, in Public Works Department, Rev.-Forests, No. 1861, dated Bangalore, 16th September 1873, will be found interesting.

* * * * * * *

The immediate object of my visit was to try and ascertain the reason of the rise during the past two years in the selling rates of our sandalwood, and whether the market in Bombay was steady, or whether the rise was owing simply to speculation. I therefore made myself acquainted with the operations of the chief importers and exporters of sandalwood, and found, as had for some time been suspected by the Officers of the Department, that the import trade is almost entirely in the hands of a few dealers. There are four of these men, two of whom, Háji Rámtulla Sét, and Háji Mitta Kásim Sét, buy direct from us. The names of the two others, Háji Abdul Raimán Bármam and Kessao Purushóttamam, have not appeared in any of our account sales

but they employ a number of agents at different times, and I found that three of our principal buyers here are actually agents for Kessao Purushóttamam; while a man named Alerika Ghulám Husén Sét, who has lately bought much wood, is only an agent for Háji Rámtulla Sét, mentioned above. Kessao Purushóttamam is also said to deal to some extent with a man named Abdul Khádar, who holds a monopoly of purchase of sandalwood from the Madras Forest Department for a term of three years.

The chief exports are made by seven firms, and Kessao Purushóttamam has also of late commenced exporting sandalwood. Though the number of men interested in the trade is not large, still there are sufficient to insure competition, which might possibly be extended with advantage to Government.

The sea-borne exports for the six years, regarding which I was able to obtain complete information, were in round numbers 2,300 tons, or a little over 380 tons a year. Taking this last figure as the average, and including the four incomplete years, we get a total export by sea of 3,720 tons out of an import of 6,050 tons, which figure is obtained by taking 605 tons as the average, and crediting that quantity to the incomplete year 1867-68.* Almost the whole of the export by sea goes to China and Arabia, small quantities only going by native craft up the coast. Wood of the first three classes goes almost entirely to China, while what is called *Jajpókal* (hollow billets) and *Bagar addad* (without number, or the small broken pieces, which are not included in the five classes of billet wood) go to Arabia, where it is either burnt whole for the sake of the fragrant smell arising from it, or ground up, or powdered and used with other ingredients as an incense. Much of the wood which goes to China is used in the making up of fancy carved articles, as incense in spells, and burnt in dwelling houses and joss houses.

There is in Bombay a fair local demand for wood of the better classes for the manufacture of carved fancy boxes, &c., and wood for these purposes is also sent to Surat. The inferior descriptions of billets are burnt by the Pársís in their fire temples, and are also used at Hindú funerals when the friends of the

* In 1866-67, we sold no sandalwood in Nagar, but in 1867-68 sold a very large quantity. The average may therefore stand.

deceased are able to afford it. For these purposes much wood is sent by carts up-country to various places in the Presidency. The wood rubbed down with water and worked into a paste is used by all Hindús in their caste marks, and is also used as an external application for headaches, and some skin diseases.

While in Bombay, I came across two funeral processions, and in both instances I saw billets of sandalwood being carried along to be added to the piles on which the bodies were to be burnt. While travelling to Surat by rail I met two Pársí priests, who got out at a small road side-station, and who had with them about half a maund of 5th class wood, which they were about to use in some religious ceremony. Much must be consumed in this manner

The greater part of the wood leaving Bombay by land is sent by road on carts. The merchants told me that they do not use the railways much, owing to losses in transit, as well as the fact that carts do the work cheaper. The wood is of all shapes and sizes, and cannot, except at heavy expense, be put up in boxes or packets. It is therefore sent loose. If sent by cart, the cartman is directly responsible for the number of pieces throughout the whole journey, and as he gets but a portion of his hire in advance, the merchant has a hold over him.

Of roots we sell about 115 tons per annum. As I have already stated, the greater portion of these do not reach the Bombay market, but are used up at Mangalore and along the Malabar Coast. About a ton of saw dust sold by us annually is re-sold in small quantities *en route*, and seldom goes to Bombay.

The stock of wood in Bombay at present is small. It is scattered over the town, but I think the total quantity falls far short of one hundred tons altogether, excluding small chips and shavings, for which there is at present but a small demand. These are being sold at the same price and in some instances at even less than what was paid us in Mysore. But chips after all form but a small item in the *value* of the wood sold, and the poor market for them is not likely to affect our sales of all other classes or the merchants' profit to any appreciable extent

In Mysore we sort sandalwood billets in five classes, a sixth is made up of hollow bad billets (or Jajpókal); roots form

a class by themselves, and a seventh class is called Bagar addad, already explained. In the Bombay market this classification is not accurately observed. The first three classes are lumped together for export, while 4th and 5th are mixed with the best of the Bagar addad, which is often sound wood, though small. Jaj and Bagar are also mixed.

Taking our average rates in all our Kótís for the last two years (the years during which the market has chiefly risen), I find we sold wood sent to Bombay at the following rates per ton :— Classes 1 to 3, Rs. 432. Classes 4 to 5, Rs. 341. Jajpókal and Bagar addad, Rs. 368.

Classes 1 to 3 go to the China market, and the selling price in China is now 22½ dollars per picul. Seventeen piculs go to the ton, and taking the dollars at Rs. 2, this gives Rs. 765 per ton. The cost of carriage from our stores to Bombay, excluding agents' commission, is Rs. 60 per ton. The freight from Bombay to China Rs. 30 per ton. Allowing Rs. 10 per ton for agents' charges in China, loss of weight, petty thefts, loss of interest, &c., the merchant will have paid Rs. 532 by the time his ton of sandalwood reaches China; thus clearing Rs. 233 per ton, or nearly 44 per cent., which after deduction of 2½ per cent. (the ordinary commission paid to the Mysore agents), leaves a profit of nearly 41½ per cent.

I could not get trustworthy information regarding the prices in the Arabian market, but in Bombay, 4th and 5th are now selling at Rs. 540 per ton, and Jaj and Bagar, which go chiefly to Arabia, at Rs. 600 per ton. The merchant who sells these classes in Bombay spends Rs. 60 in getting his wood there, and allowing for agents' charges, he makes on 4th and 5th over 33 per cent., and for Jaj and Bagar addad over 38 per cent. The trade is not burdened with any import or export duty at Bombay or elsewhere in Western British India, nor with any municipal duty in Bombay or Mysore.

Though our minute classification is not adhered to in Bombay, it is of undoubted use to the merchant; and if we were to alter it, and mix the classes ourselves, I think we would not get the same rates. A certain Frámji Pestonj offered me Rs. 800 per ton for as much of *our first class* wood as I could

supply, delivered at Bombay. I told him I could not undertake to send up any, but his request shows that our classification is known, and occasionally used in smaller transactions.

From the roots oil is distilled; the process is carried on chiefly at Mangalore. I made enquiries in Bombay regarding this industry, and believe the information given to be accurate. According to this, five cwt. (one kandi) of roots yield 40 seers of pure oil at 26 tolas to the seer. This oil sells in Mangalore at Rs. 112-8-0 per kandi of 25 seers, which gives Rs. 180 for the 40 seers, the yield of 5 cwt. of wood. Our average selling price of roots for the last two years has been Rs. 352 per ton; and allowing Rs. 30 per ton carriage to Mangalore, the sale of oil at that place gives a handsome profit.

Selling price of 160 seers of oil at 4-8-0 per seer		Rs.	720
Cost of one ton of roots at Mangalore	382		-
Cost of distilling oil per 160 seers	144	„	526
Profit per ton		Rs.	194

Which is nearly 37 per cent.

The rise in the Bombay market is alleged to be due to the rise in the price in China owing to a larger demand, and the rates have been steadily rising for the past two years. There is also a larger demand in Bombay, and the presidency itself, for sandalwood of all kinds, and I have already reported that the stock of good wood lying in Bombay is small. Since my return from Bombay I have received tenders, all at higher rates than tenders made me a month or two before my visit. The last tender came in yesterday morning. These all indicate a brisk demand, the more so that the merchants are well aware that we have just now a large stock on hand in Mysore. The tenders I submit now are as follows :—

A. Háji Abdulla Háji Abu Bákar offers for :—

1st	Class at	688	per ton.	
2nd	„ „	660		
3rd	„ „	612	„	All wood of these five classes
4th	„ „	580	„	now in store at Seringapatam and
5th	„ „	540	„	Hunasúru in Ashtagram Division.

B. Háji Rámtulla Sét.

1st Class at 640 per ton.				1st Class Rs. 600	
2nd	„	„ 592	Offers to take 125 tons of these classes at *any* of the stores in the Province.	2nd	„ „ 607
3rd	„	„ 580		3rd	„ „ 644
4th	„	„ 536		4th	„ „ 611
5th	„	„ 532		5th	„ „ 598

No. 1894, dated 19th September, Rámtulla offers.—

C. Imám Mahomed.

For all the wood of the first four classes which may be collected in the Nagar Division up to 31st July 1874 Rs. 600 per ton all round. Also offers, should this bid be topped by any other merchant, Rs. 2 per ton more than the highest bid so made.

D. Abu Sét.

3rd and 4th Classes at 600 per ton		For all wood of these descriptions in Ashtagram Division.
Roots and Jajpókal	„ 376	„

E. Háji Rámtulla Sét offers for all roots and jajpókal that may be collected up to 31st March 1874, Rs. 420 per ton.

On the 31st July 1873 we held of good wood the following quantities in tons, with the exception of chips and powder:—

	Billets.	Roots.	Jaj.	Bagar.	Total.
Nagar.	83	38	21	4	146
Ashtagram.	70	127	160	7	364
Nandidroog.	0	10	4	1	15
	153	175	185	12	525

If the most favorable of these offers are accepted, we should realize by the 28th February 1874 about two and three quarter lakhs of rupees without the value of bagar addad powder, and chips to be sold.

I found the local retail rates at Surat to be as follows:— Fourth, fifth, and good jaj at Re. 1 per 4 to 5 seers, or *at the rate* of Rs. 800 and Rs. 640 per ton. Roots sold by retail at 6 seers the rupee, or at the rate of Rs. 533 per ton. The trade in Surat is almost entirely retail, and it supplies many of the surrounding villages, using up about 50 to 60 tons per annum. I found the sandal tree growing at Surat. It is said never to at-

tain the size of the Mysore tree, and all the indigenous wood shewn me in the market was small, very yellow, knotty, and decidedly inferior in fragrance to that of Mysore. It is sold separately from our wood, and fetches about two-thirds of the price.

All our sandalwood is called in the Bombay and Surat bazars "Malabar Sandal," with the exception of the large dealers, but few of the bazar men know that the greater portion of the wood they sold came from Mysore. I told them that Mysore was the chief source of supply, and that it was the best they could get: the reason of its being called "Malabar" was simply that it was shipped from that coast. I noticed that our English stamp marks are not planed off by the dealers, and in the retail shops may be seen little bundles of wood with the stamp left intact. It is only lately that we have commenced stamping our wood in this fashion, for the purpose of identifying it and checking theft in the Province. It may possibly add slightly to the value of the wood in the market.

In column 4 of my statement in appendix is given the quantity of wood imported from "foreign external ports." These ports include Goa and Mahé, which being on the western coast, very probably ship some of our wood to Bombay, but I was told that a small quantity of Australian sandalwood is occasionally imported. I tried to purchase a piece of Australian sandal in Bombay, but could find none. Balfour, in his "Timber trees of India," states that "in 1847 nearly 1,000 tons of the true (?) "sandalwood, procured chiefly from New Caledonia, the New "Hebrides, &c., were exported from Sydney to China, where it is "burnt with other incense in the temple. The sandalwood trade "in these islands gives employment to about six small vessels "belonging to Sydney for China; it realizes about £30 a ton." I have placed a note of interrogation after the word "true" in the above. If Balfour is right in stating that Sydney wood realizes in China £30 a ton, it must be much inferior to Mysore wood, which is selling at £76-10-0 per ton. From other sources of information I have reason to believe the wood is not indentical with ours. In another place Balfour states the "sandalwood tree of the Sandwich Islands has almost disappeared." If the supply of wood failed there lately, it may partially account for the brisker demand in China for our wood.

Hearing in Bombay that a French firm, M. M. E. Bandry & Co., wished to buy small wood for export to France, I called on them, and was told by Mr. Sylvestre that there was a demand for small wood and chips in France, for perfumery. I gave him all the information I could, and also told the native merchants of this new outlet, which might prove to be a good one. In a price list I saw some time ago, I noticed that sandalwood of good quality sells in London at £70 a ton, but the demand is very small.

* * * * * *

The impression left on my mind after my visit was, that the market is a certain one; that the rates may fluctuate slightly from time to time, but that if there is no war in China, the rates will remain much the same as at present, rising if any thing, as that country is more and more opened out; that the demand in the Bombay Presidency itself is steady now, and not likely to rise or fall much; that as long as the merchants can clear 25 per cent. our rates will alter but slightly; and that we should take advantage of the present rates, as I do not think our sales are likely to glut the market, and produce a fall next year. When however we commence collecting nothing but old roots and dry wood in Nagar and Hassan, we shall realize less, but simply because we shall not have as much billet wood on hand for the supply of the market. The higher rates which may fairly be expected from reduced quantities of the higher classes being offered will partly compensate for this.

Before closing this report I wish to draw attention to a remark made by Dr. Cleghorn at page 29, para. 17, of his Note on the Mysore Forest Progress Report for 1865-66. See Government of India Reprint No. 11 of Public Works Department Records. "The trade returns shew that the annual average "export of this wood (Sandalwood) from Madras sea ports amounts "in value to about two lakhs of rupees, and most of this is the "produce of Mysore." It would be interesting to ascertain what the export from the port of Madras is, as that would give us the quantity sold by the Madras Forest Department, and which is, I believe, the wood that goes to Calcutta.

Exports of Sandalwood from Mysore, and Imports and Exports of Sandalwood in Bombay from 1864-65 to 1872-73.

Year.	Mysore.		Bombay.							
			Imports.				Exports.			
	Exports.		From Foreign external ports.		From ports in other presidencies.		To Foreign external ports.		To ports in other Presidencies.	
1	2	3	4	5	6	7	8	9	10	11
	Tons.	Value.	Tons.	Value.	Tons.	Value.	Tons.	Value.	Tons.	Value.
1864—65	423	1,78,651	14	570	741	2,91,811	...	...	...	...
1865—66	778	1,86,989	49	3,075	590	1,80,240	...	...	...	...
1866—67	321	1,03,178	66	4,401	493	1,[illegible]	165	70,902	[illegible]	59
1867—68	950	2,69,840	...	...	...	...	...	...	...	...
1868—69	691	2,83,524	1	453	608	2,30,906	406	1,82,641	107	33,640
1869—70	740	2,38,640	25	4,800	504	1,82,166	262	1,19,002	39	11,269
1870—71	715	2,30,511	9	2,612	585	2,05,892	338	1,95,752	49	12,363
1871—72	800	2,66,042	70	11,035	1,037	3,67,729	433	2,22,620	37	10,993
1872—73	714	2,76,410	1½	56	642	2,16,349	398	2,17,386	58	26,431
Totals...	6,132	20,33,765	245½	27,002	5,200	18,51,624	2,002	10,07,706	290[illegible]	94,810

The African Gum Copal Tree.

Report on "Niti Sandarusi," Copal Trees. By Captain F. Elton, 1st Assistant to Political Agent and Vice-Consul, Zanzibar.

It was difficult to arouse any interest in inquiries made at Dar-es-Salam with regard to the whereabouts of the modern copal tree. The Arabs assured me it was not worth taking the trouble to look at, and when we referred to the Banyans, who in this neighbourhood trade largely in Animé, they adopted a similar view of the inutility of taking any trouble in the matter, adding, with characteristic hankering after profit, "if the true Sandarusi could be dug nearer the coast, that would be a gain to us, but do not all know the tree copal is cheap stuff?"

Some maintained with persistency that there were no such trees now standing near here; "those seen by people before had long since been cut down; there were but few far inland;" and others seriously attempted to convince us that the existence of the "Niti Sandarusi" was questionable.

In fact, I failed altogether to elicit any information or excite any sympathy on this interesting subject amongst the more civilised portion of the community, so turned to the slave population, and instituted an enquiry on the Seyyids' plantation outside the town. Here I soon discovered, not only that several isolated trees and small groups existed within reach, but also that the slaves employed in clearing land had arrived at an extensive belt of them, where the India-rubber Uiana was also abundantly found, and which spread for a considerable distance inland.

On the 16th I left Dar-es-Salam in company with Lieutenant T. F. Pullen, Her Majesty's *S. Sheurwater*, and we proceeded with a guide in a westerly direction by narrow winding paths through broad fields of "Mhogo" and long well-tended rows of cocoa-nuts for some two miles, until we reached a "clearing" of the customary east coast description. Charred stumps of trees and felled and blackened trunks entangled with the tough half-burned ropes of the India-rubber climber strewed the ground and obstructed rapid progress over the ankle deep layers of wood ashes and treacherous "stubbing" holes on the one side, as far as the long "straw" grass and thick brushwood bordering the cultivated lands, and in the other direction up to the outskirts of a dense African forest stretching far away towards the Marni Hills and Uzaramo.

Past this clearing we found slaves busily at work hacking down trees recklessly, and from amongst these people our guide chose two slaves, one a Miao and the other a Muinde, who led the way over the wrecks of some hundreds of fallen trunks until we at last reached the borders of the wood and found ourselves amongst the "Niti Sandarusi."

We were not long in endorsing Dr. Kirk's report published in the Linnean Society's Journal (Botany Vol. XI, paper on Copal of Zanzibar and the "*Trachylobium Mozambicense*"), for both of us were astonished at the immense number and size of these trees, far exceeding anything we had before imagined. Here almost every tree around us represented the striking characteristics which will be easily noted by the annexed sketch, and the following carefully measured dimensions, which may be taken as represent-

ing an average tree, but by no means one of the largest of the group :—

	Ft.	In.
Height (top branches lopped off)	60	0
Girth at ground	4	3
„ at 5 feet above ground	3	2
Height to 1st branch	21	6
Girth at „	2	10

The trunk, which is covered with a moderately thick bark, 3-16th of an inch, resembling that of the Birch, grows perpendicularly in the larger proportion of trees to a height of about 20 to 25 feet. At this point the main limbs fork out, and from the extremities of the branches the foliage spreads into that flat-crowned appearance so common to many African trees. The fruit is of a brown color and an irregular almond shape, studded with small excrescences, the leaves glossy and of a vivid green, as the specimens forwarded will show.

On stripping off the bark we found the gum deposited in many places, between it and the wood, in a liquid form. This was also observable to a greater extent when sawing off sections of branches; where the tree was injured a resinous gum had collected in considerable quantities, and was also seen on several trees on the lower sides of the branches; on the upper sides none was seen.

The Muinde climbed up and stripped off several specimens with a knife, but none of these run to a large size. The larger pieces, we were told, are found at the foot of the tree where, falling, they become buried in the sand. The Miao told us his wife received a dollar altogether for what she had dug at the foot of the tree in the sketch, a rotten branch of which had fallen.

Marks of digging were observed in all the surrounding soil; however I am not inclined to think the gum falls in a liquid state, for no extensive deposit is noticed except where a state of decay exists; hence it is probable that where trees have been left to fall to pieces from sheer old age, large quantities may with reason be expected to be found buried and to have survived all traces of the tree itself on the ancient site.

Insects innumerable live on the Niti Sandarusi. One branch was cut down in which a family of ants had formed a large nest behind a wall of the gum, and were rapidly undermining the heart of the wood. Between the bark and the wood, on stripping the former covering, legions of ants and wood-lice were seen, and a small green lizard with a yellow head, striped longitudinally with black lines, was pointed out to us as peculiar to the tree.

Indeed one can readily understand that it must be a mere question of sufficient time to produce gum which must necessarily contain imbedded specimens of the various insects common to the Sandarusi, and in a half decayed tree one would expect to meet with many such evidences of the former inhabitants, but not with the leaves or fruit, which are only found growing, as I before noted, at the extremities of the branches and remote from the situations in which the gradual formation of the copal commences.

The conclusion, then, which both Lieutenant Pullen and myself arrived at is, that the attacks of the swarms of ants and other insects lead invariably to the slow but sure destruction of these trees, piece after piece, branch after branch; as the heart of the wood becomes undermined, the tree throws out the resinous gum in considerable quantities: almost it would seem in an effort to arrest the process of decay, which occasions finally its fall, after which but a few years would be necessary to bury the wreck in the shifting sand which covers the surface of the sienna-colored sub-soil rich in vegetable remains in which the copal tree is found.

Almost all these trees were festooned with the long intertwined ropes of the India-rubber Liana, the thickly matted cords of which pendant from the main limbs and knotted into a sort of rigging become an easy means of ascent to the natives looking for the resinous deposits on the branches. This India-rubber was worked rather extensively here at one time, but was soon given up as unprofitable in consequence of the number of slave lads carried off by leopards; now, however, it does not appear to strike the Sultan's overseers that it would be more lucrative to collect it as they move on with the clearing, than to cut down and burn the Liana by hundreds.

Our guides easily worked up two large balls of India-rubber for us. After making deep longitudinal incisions in the main ropes of the Uiana, the milky substances which exuded profusely they smeared on the fore part of the left arm. When enough had been procured, this was stripped off in flakes and rolled up in the hands until it assumed the shape of a small dumpling. At Dar-es-Salam this article of commerce commands a price of from $9 to $10 per frasilah of 35lbs. weight.

The slaves told us that you could travel for two days into the interior before losing the "Niti Sandausi," and that during the whole of that distance the India-rubber was commonly parasitic to the trees. At the rate the clearing progresses, however, it will not be long before this copal tree-wood becomes a thing of the past.

At a second visit, when we worked along and into the wood, all we saw only confirmed the conclusion we had already come to; however, I trust, after inspecting the principal diggings, to be able to give a more detailed account of the situations in which the tree is found, and its relation to the fossil Animé.

ROYAL BOTANICAL GARDENS, CALCUTTA.

I have read with much interest Captain Elton's report on the African gum copal tree. I think he and Dr. Kirk are quite right in their conclusions of the origin of this gum.

It struck me much that this tree and also the caoutchouc climber *Landolphia sp.* might advantageously be introduced into Southern India (Malabar and Travancore), and also into Burma, where they would flourish in the laterite grounds if not too rocky. The stunted growth of the Zanzibar forests points to physical relations similar to those existing in the British Burmese forests. It would be really a great gain if also the ripe fruits of the African caoutchouc climber could be obtained for trial. I have retained also several fruits of the copal tree for sowing. These contain apparently quite sound seeds, and I have good hope that they will come up. If so, it might be arranged to send some of the young plants to Burma and Southern India, for I fear they will not succeed well in Calcutta.

S. KURZ.

From 1st Assistant Political Agent and Vice-Consul to Her Majesty's Acting Political Agent and Consul-General, Zanzibar.

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EXTRACT.

Our day's journey, which I estimate at 19 miles, lay through a gently undulating grass country, with extensive belts of fine trees (amongst which the "Miti Sandarusi" was frequently to be seen), stretching away to the foot of the hills making the Uzeramo country, and only broken here and there by a gentle rise, or an outlaying "Shamba," with its surrounding clearings and "Mohogo" field.

Everywhere signs of copal diggings were visible. In fact, we were passing through the main fields from which the Zanzibar market was once almost entirely supplied, and which still produce this valuable gum in considerable quantities.

The process of digging is a simple one. Twenty to thirty men, generally of the neighbouring tribes or free men, form a party and spread over a stretch of country, which they divide amongst themselves into clans, each of which is worked by five or six of their number. Operations are commenced in each instance by driving five holes to the depth of about two feet as a prospect. If the yield is encouraging, four more holes × are driven, which are followed by the levelling of the whole square to the orthodox depth of about three feet, deeper than which no shafts are sunk. One square being worked out, a new one is commenced and prospected in precisely a similar manner, until all likely ground is gone over; purely sandy soil without a sub-stratum of fibrous and decaying vegetable remains being passed by. The salemen, chosen from their knowledge of the coast trade and villages, then effect a sale, for which they receive an increased share over and above the rest of the workers, and after the division of profits all knock off work until compelled by want of money, *i.e.*, goods, to take to the fields again. The trading generally takes place at night in the house of the Indians (whose principal business is copal dealing), and should no bargain be arrived at, the Washenzi leave before daylight, sleep in the woods, and return again at dusk to resume negotiations. As the gum is brought in, it is an admixture of

0	×	0
×	0	×
0	×	0

the tree, the chakazi, and the true (so called fossil) copal, and, I fancy, is still further doctored on its way reaching European merchants.

From 1st Assistant to the Political Agent and Vice-Consul, Zanzibar, to Acting Political Agent and Consul-General, Zanzibar.

The "Msandarusi," or copal tree, is largely scattered over the extensive tract of country stretching from the Marui hills and the Uzeramo, through the rich district of Kwele, away to the Matumbwi range of mountains on the south-east of the Rufiji River, and lies within the limits which are bounded to the east by the sea-coast line of cultivation and settlement, and to the west by the highlands which form an irregular barrier to the Mrima at a distance of from 30 to 35 miles inland. Throughout these limits immense quantities of the semi-fossil "animi" are dug by the natives, and this produce constitutes the most lucrative commerce of the Indian settlers at the small trading ports.

Farther south, beyond the Samanga villages, there is a break in the supply, probably occasioned by the surrounding slave traffic, which rapidly drives legitimate business and all confidence out of its path, but also affected to some degree by the increased difficulties of communication caused by the marshy swamps, which here fringe the coast more deeply than above the Rufiji. However, beyond Kilwa, copal again re-appears, and is largely bought up in tranquil times at the numerous trading stations which dot the sea-board down to the Rovuma River.

The "old working," close to the village of Massonga on the Kisiju road, from which many ships' cargoes of "animi" have been extracted, appear to be now almost exhausted, for although small parties re-work the ground occasionally, it is neglected by the men, who habitually supply the Indians, for a tract of land bordering on the same road, a little further to the south, and situated in the district of Mangatani. In this country a forest, called the "Kiregesi," contains many "Msandarusi," and between the belts of these trees and in the broad transverse glades, which always intersect African woodlands, some of the finest fossil gum is dug. This never reaches the trader, however,

without a large admixture of the copal from the neighbouring trees, and the contents of the digger's basket are made up with wet sand and small stones, in order to gain a little extra weight, it being war to the knife over the barter of "animi" between the Indian and the Washenzi, a contest in which both sides are equally unscrupulous.

Dar-es-Salam is only sparingly supplied with the gum, the trade being diverted to Mgogoni, Tuliani, &c., but the immediate vicinity furnishes this part of the coast with ease, and at Mangatani the agents of the Banyans buy for Kisiju, Bosa, &c.

The extent of the produce is not fully realized until the Kwale District is entered. Here are found the following stations where the trade is carried on systematically:—Kitmangao, Zerare, Nusseebgani, Kunderani, Demuni, Makrora, Kivinja, Sandazi, Mji-Mema, Pemba, and Kikunia, all of which are almost solely occupied in this one commerce. In the early morning strings of natives are seen on the paths, each party led by a few men armed with old muskets and bows and arrows, and consisting of women and lads, carrying copal baskets, and except during the very dry season, these arrivals take place daily, yet, even here there is no organized system of working; "prospects" and shafts are seen almost everywhere, but a regular supply cannot be insured, no pressure can induce an increase when enough gum has been bartered to satisfy the present demands of the petty Chiefs. Neither do the Indians venture to send out parties of their own, each village and each working is represented by a headman or "Jumbe," and the natives are only too ready to unite against the slightest encroachment on their monopoly, the "trade union" system being here represented in its strongest form.

However, during the rains there is not much slackness, the ground being soft and easier to work with the rough hoes and pointed sticks used to clear out the holes: below 4 feet no fossil gum is found worth taking, and indeed very few diggers appear to go beyond 3 feet in search of it; but all is grist that comes to the mill, copal from the tree, the copal dug beneath the branches, fossil copal, and the decayed gum, and the difficulty of arriving at any fair valuation of a quantity must in consequence be great.

My opportunities of visiting both diggings and trees in this district were frequent, and it is from here that the specimens forwarded were collected, as also the fruit, which the natives state to be fit for planting; and I find no reason to induce me to alter any points in my former report on the "Msandarusi."

Sandazi boasts of a giant copal tree, which overshadows the main street of the village, and is superior in size to any others I met with; but even this really noble specimen is often excelled, I was assured by the natives, by trees found nearer the hills. At Kikunia a brisk trade flourishes in the gum with the Rufiji tribes and the Mtoti. Past the Mpenbeno Ferries on the Rufiji, and skirting the plains which stretch to the Mutumbwi Mountains, Mohoro is reached (a village on the river of that name, which enters the sea at Pemba Utagiti, but does not belong to the Rufiji Delta), and both here and at Furu, Murdengo, Kuajo, and Samanaga, and at an inland station called Chabwani, the principal business is copal.

Beyond the Samanga group of villages, the road towards Kilwa Kivinja passes through difficult mangrove swamps, and the country is thinly populated and very unhealthy. Kilwa reached, slave-trade and ivory monopolize all attention, and what little copal trade there is has dwindled down to small quantities brought in by the slaving expeditions, which venture a few days' journey from the town.

The district of Mungao is now in such a disturbed state that all trade is closed, except at Lindy and Mzinga, several natives having been killed whilst on their road to the settlements laden with the gum; but in peaceful years large quantities arrive from this part of the country at Zanzibar. Kwale and Delgado exported $40,000 worth so long ago as 1867-68, since which date, I believe, no correct returns of the southern trade have been kept.

The Indian trader on the Mrima has many extortions to fight against and heavy duties to pay, neither can his life be a very pleasant one, spent, as it is, in one continual succession of haggling and quarrelling with the natives, in competition with his neighbours, and a monotonous round of coast fever. The local Jumbe extracts a ground rent from him, and he is fortunate, if

only one claimant to territorial dues appears on the scene! The Jumbe is followed by the Jemadar, who levies an arbitrary percentage on his supposed profits, and besides estimates the amount himself in order to save discussion. The Custom House then abstracts 20 frasilahs from every 100 frasilahs of copal shipped as the Government duty, and, in addition, charge him on expenses, storage, and delay. Add to all this, freight and interest on money, and a considerable addition is made to cost price.

Three to as high as 54 Dollars are the Kwale estimated cost of the barter per frasilah of copal from the Washenzi, prices varying according to the season of the year, and the number of the men of the various tribes at work, demand, &c., and at Zanzibar the merchants buy at from 87 to 8, according to their written agreements with the Coast Agent.

Against all difficulties the trade undoubtedly prospers, and affords large gains to all concerned, whilst it is clear the apparently inexhaustible supply of copal, under a settled rule and with systematic working, would furnish the means of supporting a far larger community than that now sparsely scattered along the Coast.

The tree would appear to have lined the shores in old days, but the extent of the ancient forests can now only be estimated by the area of the present workings and by the position of the existing "Msandarusi," which are found away to the foot of the low hills bordering the Mrima and on all the terraced lands sloping down from the ridges to the present sea beach. It seems also impossible to estimate the time required to effect the change of the tree gum into the so-called "fossil" animi, although all local evidence confirms the identity of the origin of these two articles of commerce, the difference in the value of which is so great.

II. Reviews.

The Indian Forester in France.

Among the most hopeful signs of progress is the growing interest of foresters at home in Indian forestry. If forestry is to become in India what it has become in Europe, it will be mainly by a strong combination of forces, by a thorough understanding between all branches of the local forest service in India, and by an "*entente cordiale*" with foresters at home.

It is with much pleasure that we have observed recently several notices of Indian forest matters in the "*Revue des Eaux et Forêts*," and latterly in the *Journal d' Agriculture pratique*, which latter contains an article by Colonel Pearson, on one of the most interesting groups of forests, the sâl and teak region of Central India.

The first part of the paper deals with teak, and although there is in it much valuable information, there are also some curious errors.

For instance, the Burman forester will be delighted to learn that the exploitation plan of 1868 allows 10,000 teak trees to be annually felled in the forests! It is not moreover correct to say, at any rate in Burma, that the teak loses its leaves in November; they do not fall till the dry hot weather. It is this circumstance which renders the formation of humus by the decay of the leaves so difficult in Burma. In the hill forests, the dry leaves are invariably baked to tinder by the sun, and then the forest fires destroy them in a minute.

It is said that the regeneration of the teak forests is the greatest difficulty with which the forest administration has to contend: surely this is rather too strong. The natural regeneration of teak is only difficult as long as forest fires continue, and in India forest fires continue only by reason of the supineness of local governments and administrators, who will not effect the definition and regulation of grazing rights or privileges, which in about eight cases out of ten are the origin of forest fires. In Burma forest fires are not caused by grazing, but "toungyà" cultivation: for this, demarcation of reserved tracts is the remedy. But then comes a still more extraordinary phrase. "Le teak est tellement *peu garni de feuilles* qu' il ne donne au sol qu'un abri très faible."

Considering that teak has a magnificent crown of huge green leaves, forming a thick shade over head, this can hardly be seriously meant. What is intended is probably that as the teak loses its leaves completely, and remains bare till the rains set in, the soil during that time becomes parched and baked by the full force of the summer sun.

The result, as regards the destruction of the leaves, has already been alluded to, and certainly the total absence of a humus layer in the siliceous sandstone hill forests of Burma is one of the most notable features: the steady deterioration of the soil appears to be admitted, and a definite remedy is urgently called for.

The reproduction of teak is, if the remarks include Burma, somewhat misrepresented throughout. It cannot be said that the cultivation of teak presents enormous difficulties, especially when we consider the great success which has attended its cultivation by Karens. These hill people obtain portions of land to clear and cultivate by "toungyà" for one year, on condition that they raise teak trees at 6′×6′ all over the area and tend the young plants for 2 seasons; after this they hand over the stocked area to the forest officer.

It is not moreover true as a rule that the vegetation of other species is more active than that of teak; but the fact is, that teak will not bear cover overhead, and if it is planted where such cover exists, and where rank plants and jungle can get the better of it, it will first languish and then succumb altogether. Teak is in its first years of extremely rapid and powerful growth.

We cordially concur in the author's remark on the necessity of putting the coppice teak of the Central Provinces under an "arrangement" of conversion into high forest. It is quite true that at present the *local* demand is for coppice poles and small rafters, but this is not a sufficient reason for abandoning all thought of growing timber, and can only be a reason for working a portion of the forests by coppice, or rather for making it coppice with reserved standards.

The description of the sâl forest which then follows is excellent; and a sketch plan exhibits the distribution of the teak along the Vindyan and Satpoora Hills, and on the Godavery river, and shews also the outline of the great central sâl belt

which occupies the whole of Chota Nagpore and the eastern portion of the Central Provinces as far as the sources of the Mahanuddy, and occupies no inconsiderable portion of the country of the eastern ghâts, extending down into the north part of the Madras Presidency.

This sâl belt exhibits greater signs of destruction than the northern or Sub-Himalayan sâl belt, which stretches along below the hills from the Jumna to Assam. The administration of it is still on the most unsatisfactory footing. In Bengal nothing has yet been done, in spite of representations on the subject, to protect any part, even where such protection is possible.* In the Central Provinces, though the forest—and this applies to the teak tracts also—are "*debarrassé*" of all forest rights, yet they are only really preserved to an extent of about 2½ P. C. of the whole area of the province.

While thus pointing out what appear to us errors in the paper under review, we are not depreciating in any way its value. Some of the mistakes are probably due to the "*redacteur*" rather than to the original intention of the author. On the whole the paper is pleasant and readable, full of information, and presents just such a sketch of an important section of our forest area as is most desirable to give in Europe.

We hope this paper will be followed by others, describing the deodar forests, the Burma teak, the Eastern Himalayan forests, and many other localities of interest.

One thing COLONEL PEARSON may look to with satisfaction in writing an account of a tract of country which has been for some time under his administration, and that is one, too, which deserves prominent record in our pages, *viz.*, that COLONEL PEARSON was the first Conservator in India who coped successfully with forest fires. Under his administration, the Central Provinces alone shewed an example, which we are happy to say the Berars and other provinces are now following, of absolutely protecting a considerable portion of its forests from fire. Several of the forests have been now protected for seven or eight years consecutively; and in 1872-73 the portion of the area protected in Central India amounted to 114,542 acres.

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* Since the above was written considerable progress has been made in Bengal.—*The Editor.*

Indian Forests.*

By J. L. Laird.

This little pamphlet is a reprint of an article in the 1874 volume of "Aus dem Walde," a forest periodical edited by Dr. Burckhardt, Director of Forests in the province of Hanover, and is dedicated to Anglo-Indians who are familiar with the German systems of forestry.

The author has, from time to time, made the acquaintance of Indian forest officers travelling on the Continent, from whom he has obtained the information regarding Indian forests contained in the present essay.

After some general remarks on physical geography, the vertical distribution of forest species, and organization of the *personnel*, the writer describes the method of exploitation until lately in vogue, and the improvement which it is hoped to effect by gradually confining the cuttings to smaller areas.

As regards re-stocking, Dr. Burckhardt is of the opinion that Indian forests "should be regenerated by self-sown seed, and that only in exceptional cases artificial methods should be resorted to." We heartily agree with this opinion, and think that natural reproduction by mother trees, or something similar—such as planting under standards—should be tried on a small scale, and if successful, be introduced more generally. The financial advantage of natural regeneration is obvious. On the one hand, we have an immense expenditure for nurseries, planting; and watering; on the other, none. The question is: would this method succeed? Experiment alone can tell; but there is good reason to hope that, in parts of the country, it would. "Imitate Nature" is a favourite maxim with those who pride themselves on being practical, and in adopting the natural system we would be merely carrying out this principle. It is, moreover, at least reasonable to expect that, if trees in a forest left to itself reproduce themselves spontaneously *by seed*, a treatment almost identical would give almost similar results.

* Aus dem indischen Walde, insbesondere uber den Teak und Salbaum. Separatab, druck aus dem V Hefte "Aus dem Walde" vom Forstdirector Burckhardt, Hannover-1874.

Dr. Burckhardt seems to be in favour of retaining the primitive method as a general rule, but of gradually concentrating the cuttings, and confining them strictly within certain limits for certain periods. We must confess that we cannot see much difference between this and natural regeneration; all that would have to be done would be to carry on "concentration" a little further perhaps. In any case, the character (trees of all ages mixed up together) of most of our forests would not admit of any sudden change, so that the degree of localization is not a matter of much importance for the present.

The object of confining operations to more limited areas is clearly shown. "Concentration facilitates regeneration; for the cuttings, being smaller, can be more easily inspected, and supervision is not relaxed until the young crop is fully established. But the reverse is the case when blanks are scattered over large areas; they are then easily lost sight of altogether, and cattle grazing is all that is wanting to cause the disappearance of any seedlings that may have sprung up. The result is incompletely stocked woods, so frequently seen in India; and it may be stated as a general rule, that the more extensive the cutting, the less complete the stock of young growth.

For the same reason the wood cut is more easily checked and guarded. Even the mode of transport may be affected, as roads pay only when large quantities of material have to be extracted."

Farther on we are reminded that wood loses as much as 80 per cent. of its weight and half of its volume by being converted into charcoal, and that where the transport of firewood does not pay that of charcoal might.

Special chapters are devoted to teak and sâl. The reason given to explain why unmixed woods of teak are unknown, *i.e.*, because this tree is exposed to more dangers than other forests trees, is, to say the least, very vague, and we think that a more satisfactory explanation might be found. Trees demanding much light—and teak is one of this class—cannot, except under very favourable circumstances, compete with trees preferring shade. Everyone knows that the oak, in spite of its more rapid growth, is seldom able to struggle unassisted against the beech; might we not

conclude, by analogy, that the same cause prevents the spread of teak, which is the representative in Indian forests of the oak in European forests?

Dr. Burckhardt recommends that small, unmixed clumps of teak should be grown in mixed woods, because "treatment and protection from suppression would be easier in the case of clumps than in that of isolated trees, and because lateral growth could be better regulated by thinnings."

He is decidedly averse to unmixed teak woods, on account of their open character, and the consequent exposure of the soil. In such forests, he recommends the adoption of Von Seebach's method, which consists in increasing the severity of the thinnings as soon as the trees have attained their full height, and at the same time raising, under the older growth, a second crop. The object being to accelerate the lateral growth of the standards by liberal thinnings, and at the same time preserve the moisture of the soil by means of the undergrowth. This method has been found to answer when large timber, or a sudden, but temporary, increase in the yield, was required.

The writer describes the means adopted by Dr. Brandis for estimating the annual yield. It is simply this:—The trees are divided into four classes, *viz.*:—

Trees from	0 to 12	inches in diameter, or	IV	Class.
"	12 " 18	" "	III	"
"	18 " 24	" "	II	"
"	over 24	inches in diameter, or	I	"

Having estimated roughly the number of trees in each class, by measuring the trees on a part of the area and then deducing from the data obtained the crop of the whole area, it remained to determine how many of the first class might be cut yearly, until those of the second class had grown into first class trees: The number of trees divided by the number of years required gave the annual yield. To find out the mean annual increase for each class, sample trees of average vigour were felled, the annual layers counted, and the diameters measured; the sum of the diameters divided by the number of rings then gave the mean yearly increase. Thus, if the mean annual increase of a forest were found to be ·1 of an inch for the second class, it would take 60 years for this

class to grow 6 inches, and our first class trees would have to last for that period.

Dr. Burckhardt thinks that the method of natural regeneration could be applied with advantage to the sâl. He tells us that it is frequently found in unmixed woods; that this fact, the lightness of its winged seeds, the ease with which it is propagated spontaneously, and the protection from running fires afforded by dense thickets, would warrant a trial of the method.

A perusal of this little book will well repay the trouble. The conclusions the author has arrived at are modestly stated; they appear to be well worth consideration, and are a proof—for the writer has never seen an Indian forest—that "the principles of forestry are everywhere the same."

III. NOTES AND QUERIES.

(CHINESE BLACK-WOOD IN BOMBAY.)

WILL any correspondent in Bombay inform us what species of tree is indicated by the name Chinese Black-wood, and how seed of it can be obtained? Does it require a heavy rain-fall, or would it grow in North India? Any particulars of the experiments in Dharwar would be valuable.

B. H. B. P.

FIRE LINES.

The work of burning fire protection lines varies in different places so much, that it is a good thing to collect different experiences from different quarters.

In the Dehra Doon the rain-fall is good, but during the winter and dry months the nature of the soil in the sâl forests, where there is very complete sub-soil drainage, causes the surface to become and remain very dry. It is remarkable in this district, how the *slightest* covering of grass will sustain a fire and allow a kind of smouldering, hardly visible combustion to creep along, till all of a sudden it reaches a mass of material beyond, and bursts forth in flames.

The following method of cutting fire lines in very inflammable localities, tried by Captain Bailey, Deputy Conservator of Forests,

seems worthy of record; it controls the fire by cutting the lines like a ladder.

I had lines burnt round 6 patches in the Boolawala and Lucheewala Forests, in the Eastern Dûn. The area of these patches was about 215 acres, and the length of line surrounding them was 6½ miles.

I have satisfactorily determined that no unburnt line, in which there is any vegetation, is of the slightest use in stopping a fire.

I tried some experiments by cutting the grass as low as it was possible to cut it; but there was always sufficient left to carry on the flame, which passed rapidly over the line, rising several inches high.

I commenced to burn round the patches in the month of February. I found that in the early mornings the grass was so wet that it could not be made to burn at all.

After about two hours (9 A.M.) it seemed suddenly to have reached the burning state, and in a moment an enormous fire sprang up, which was with the greatest difficulty suppressed.

The flames rose so high, and the heat given out was so great, that the men could with difficulty be persuaded to go near it. After this I did not consider it safe to light the fire again that morning.

About 11 A.M. a strong breeze sprang up and continued all the evening, and it was impossible to light the fire again that day.

I however directed that during the day strips of grass about 6 feet wide should be close cut with a "durrântee" down each side of the line which I proposed to burn, and that the intervening grass should have cross paths cuts through it at every 50 yards. Thus the whole area was divided into small patches.

The next morning, as soon as the time arrived at which the grass would burn, I fired each of the patches so formed in succession.

A gang of 20 men stood round the burning patch, with green boughs to prevent the fire from spreading across the cut lines, and to put out any sparks which might be blown over them.

The greatest watchfulness was required, but the plan seemed to succeed.

The great advantage of this arrangement is, that the men can be usefully employed all day; and that within reasonable limits; it is as easy and as cheap to make a wide line as a narrow one, the

only increased labor for a wide line being the extra length of the cross paths or runnings of the ladder.

The plan recommended may be carried on with safety if a gang of 20 coolies under a sharp tyndale is employed; but I think the paths might be made 10′ wide if the grass be long and thick; and if it be very dense, the cross paths might be made at closer intervals than I have described.

The great object is to prevent the fire getting too much a head, and thus becoming beyond control.

The grass on the paths or strips should be cut as close as it is possible to cut it with a durrântee.

B. H. B. P.

Wood Ashes.

Coniferous trees, I find it noted in the *Revue des Eaux et Forêts*, give 3 times less ash than deciduous, and therefore require 3 times less of inorganic matter in the soil. Moreover, the leaves of pines are fleshy and persistent, which enables them to draw a larger amount of nourishment from the air. The roots in consequence have a more spreading nature and less tendency to go downwards vertically.

From the same journal I observe the following:—

10,000 parts oak give	...	250	parts ash.
,, lime (Tilia) give	...	600	,,
,, fir ("Sapia") give	...	83	,,

And for a general average it may be taken that woods give 2·5 per cent. of ash (other than conifers).

Supposing, then, 700,000,000 kilogrames (1,540,000,000 lbs. nearly) to be annually consumed, the quantity of ashes would be 17,000,000 kilos (or nearly 38,000,000 lbs).

Now all this ash contains quantities of phosphates valuable to the soil. 100 kilos of the ash of beech will, according to Liebig, contain 25 kilos of phosphates.

M. DeL'arminet gives 12·2 as the percentage of phosphates generally.

The value, therefore, of most ashes as manure is enormous—where do they all go to?

B. H. B. P.

Pinus Excelsa.

The following curious notice is extracted from Major Madden's well-known but not very accessible papers on the "Himalayan conifers" in the journal of the Agri-Horticultural Society of India. Have any of the correspondents observed any similar phenomenon, and can they give an explanation of it?

"During a fine dry winter, such as the present one of 1844-45, in the months of December and January, the leaves of the *kaeel* pine (*Pinus excelsa*) were completely covered by a sweet transparent liquid substance, which collected on the branches and leaves, and as it dried matted the latter as if with ghee. This substance concreted into a pure white manna of the consistency of honey or sugar, hanging down from the branches in the form of long or rounded 'tears.' In this state it is eaten by the hillmen, and is extremely sweet and palatable, without any flavor of turpentine. Abundance of it also falls to the ground, where it covered the stones with a coating as hard and transparent as the finest varnish; and the leafless branches of willows, &c., were quite enveloped by it, as with so much French polish. It was also produced on the cedar, oak, and *Andromeda*, but far less copiously than on the *kaeel* pine. The mountaineers believe it falls from Heaven; to me it seems to exude from the leaves, but Captain Hay informs me that it was in fact secreted by a species of *aphis* of a dark brown color, about one-tenth of an inch in length, which was to be seen in multitudes on the branches. We learn from Burckhardt * that the manna of Mount Sinai, still called Manni by the Arabs, drops from the tarfa, a species of tamarisk, probably our 'fuvas,' only in years when copious rains have fallen, as last season at Simla."

B. H. B. P.

On the Killing of Trees.

It may not be generally known that in some parts of Burma the people have a very simple method of killing exogenous trees which do not succumb to the ordinary process of ringing or girdling, such as cutting into the heart wood and making a clear line of severance though the sapwood.

* Travels in Syria, pp. 599-604.

The trees in question, which are of course those which have but little heart wood, or probably no real duramen at all, are ringed to the depth of several inches in the hot weather, and the incision there made is filled with moist earth or clay as soon as the rains sent in.

The first operation has apparently no effect whatever, and one is at a loss to comprehend why the ringing and application of clay should not be undertaken at one and the same time.

Undoubtedly the clay acts as a check to the anartomosis of the bark and sapwood over the incised part, and to this must be attributed the death of the tree.

It would be very interesting if any one well versed in structural and physiological botany would explain the actual effects in detail of the entire operation on trees of this description.

W. J. S.

On Transplanting.

The Government of India letter No. $\frac{1}{5}\frac{1}{7}\frac{1}{9}$ of 28th May 1874, circulating Mr. J. Ballantyne's report on the taproots of teak seedlings, has just reached me.

In Assam I consider it best not to transplant at all, but to put down the seed at what we call at stakes or on the spot it is to grow in, 3′ × 6′, 4′ × 4′, or 6′ × 6′ distances.

Next to this, transplanting of small seedlings 2 to 3 inches high is considered far better than the transplanting of larger seedlings, in fact, the latter is never attempted. The same method of course could not be advocated in all the varieties of climate we have in India. I hope residents in other parts of India will let us know through the medium of our new forest paper what they consider the best, and how they manage.

G. M.

American Forests.

Constant and reckless destruction of our forests is fast bringing us to a condition in which there will be occasion for real alarm. It is not probable that any "scare" like that which a few years ago went over England, concerning the prospective exhaustion of her coal supply, will immediately occur in America touching the loss of our forests; but we wish something near enough approaching it might happen, to stop a work that is full

of evil promise. In the whole of the United States there is left but one really great tract of timber. It lies at the far extreme of our country, and consists of about one-half of Washington territory and a third of Oregon. California has, perhaps, 500,000 acres of forest now, of which fully one-half has been cut away within the last two or three years. Here in New York we have no considerable forest left, except in the Adirondack region. Our wealth of maple, walnut, and hickory is substantially gone, and a large part of it has been wantonly destroyed. Wisconsin had a magnificent forest growth, but the people are sweeping it away at a marvellously rapid rate. One billion feet of timber was cut in a single year. It will not take more than a decade or two at the utmost to fairly exhaust this source of wealth to the State. Michigan and Minnesota are following in the same course, slashing away at their forests as if a tree had no right to lift its head. One of our most intelligent army officers, General Brisbin, who knows the western country thoroughly, and to whose accurate knowledge of this subject we are indebted for many facts, says that 50,000 acres of Wisconsin timber are cut annually to supply the Kansas and Nebraska markets alone. The Saginaw forests are even now practically destroyed, and if the Northern Pacific Railway is built, it will open up to the axe the one remaining belt of American timber, in Oregon and Washington territory. The railroads have been the great destroyers of our forests. They use 160,000,000 of ties annually—that means the levelling of at least 150,000 acres of trees. The timber they use, also, is not the refuse or the inferior, but among the very best, fine young trees, 8in. to 10in. in diameter. If it is remembered that ties have to be renewed every seven years, the extent of demand on our forests will be appreciated. When 10,000 miles more of rails have been laid, it will require all the young trees in the country to supply the demand for ties. Fences are also enormous consumers of trees. In the East we are learning in this regard economy from necessity, but in the West, in some States, the farmers cut down the forests with scarcely more thought than they harvest their grain. The fences of the United States, people may not generally know, have cost more than the lands, and are to-day the most valuable class of property, save

railroads and real estate in cities. Illinois alone has $2,000,000 invested in fences, and they cost annually $175,000 for repairs. In Nebraska, where excellent herd laws are in force, the necessity for fences has been so much lessened that the fences of the State cost less in proportion to population than in any other in the Union. The outrageous waste of timber caused by the felling of forests and burning of the trees to bring the land under cultivation goes on still at a fearful rate. From 1860 to 1870 no less than 12,000,000 acres of forest were thus wantonly destroyed. For fuel also vast tracts are levelled of their trees. It took 10,000 acres of forest to supply Chicago with fuel in one year—1871. Our annual decrease of forest from all these causes is not far from 8,000,000 acres. Yet we plant only 10,000 acres of new forests a year.—*New York Times.*

THE DECREASE OF WATER IN RIVERS AND SPRINGS.

The following data have been taken from a speech by Hofrath G. Wex at the Annual Meeting of the Geographical Society at Wienna on the 22nd January 1875.

Hofrath G. Wex stated that observations show a steady decrease of the quantity of water in rivers, and an increase of floods. Observations made show the following decrease during the last 50 years. On the river "Elbe" 17 inches; on the "Rhine" 24·8 inches; on the "Oder" 17 inches; on the "Weichsel" 23 inches; on the "Donau," near Orsowa, 55 inches. Corresponding with the above an increasing drying up of springs has been observed. If this was to go on, the German rivers would cease to be navigable, the smaller streams would dry up, the lives of plants and animals would be endangered; and by these means the existence of future generations would be threatened. The chief cause of these phenomena is stated to be the reduction of the area of land under forest, whereby not only a reduction of atmospheric deposits is caused, but also the falling rainwater rushes down the bare hill sides, causing temporary floods, whereas in land under forest the rainwater is retained as ground water, which feeds springs, thereby securing a steady flow of water in the rivers. Should not we here in India take a warning by such startling effects of forest devastation?

W. S.

IV. SHIKAR AND TRAVEL.

How I shot a tiger in a house.

"SAHIB, bagh ka khubr aya." These words, so often heard, but never without a thrill of expectant pleasure, came from a chuprassie, almost as keen in the search of shikar as his master. I was sitting in my sanctum deep in one of those many reports which leave a district officer less time than of yore for shooting; but considering the protection of life and property of paramount importance, the report in this instance had to wait.

I soon heard the particulars.

A tiger in a village 10 miles off—but not merely in the village, in quiet possession of a dwelling house—a cow killed—a man mauled—could any khubr sound more promising?

The khubberier had come in hot-haste, taking some 2½ hours only on the road; the tiger was in the house when he started, and he was quite certain it would not dream of moving off until we had inspected it.

Quickly were the orders given for elephants, howda, and rifles to be got ready, and the following chit fired off to M., a right good fellow everyway, including proper love of shikar.

DEAR M.,

Khubr! Tiger in a house waiting to be shot. Will you come?

Yours.

Back sped the answer "all right."

It was now 10 A.M., and alas all the elephants were out for charra. Could we expect them up in time to find the tiger still in the house, or even in the village? It seemed most doubtful. Close to this village, too, is very heavy jungle, where M. and I only the week before shot a tigress; but then we had a kill in the jungle as basis of our operations, or rather four kills, as four cows out of a herd had been killed and carried into the jungle and without a kill in such jungle you might as well look for the traditional needle in the haystack of our childhood as for a tiger.

Expedition was everything, so I galloped off to our Police lines, some two miles distant, and ordered out sowars to hunt up

the elephants, with instructions to the mahouts to proceed direct to the village without coming in for our howdas, which we sent on carts to a musjid a couple of miles out, a point where the elephants could pick them up without having to go out of their way.

It was after midday when M. and I started; a sharp canter of some four miles over a road which would have been good had those three letters of the alphabet P. W. D. never been placed in such close relationship to each other, brought us up with the elephants. Two howdas, four beaters, not a big line, but enough for our purpose.

It was no good our going on before the elephants. So for the last five miles or so we went leisurely along, speculating every now and then as to the possibility, almost rather the improbability, of our finding stripes still in possession.

It was a very pleasant ride, a bright cool day in February last, agreeable climate, good green turf to ride on, a tiger waiting for us, and not least, though last named, as companion a friend who had shared with me many a previous day's sports. Could any ride be more pleasant? Dear reader, do you recall those pleasant rides down the velvety turf-clad lands of dear old England, when your companion was perchance one of the fair sex, and think you could have rides infinitely more pleasant than that I describe? Of course you can, but you may believe me that these rides out to our "happy shooting ground" cement old friendship and live pleasantly in our memory long after the shooting days are past.

About the tenth mile we reached the camping ground on the J. nuddy. Here we were met by some of the excited villagers, with the assurance, almost too good to be true, that the tiger was still in the village.

We now got into our howdas. Mine was on Maula Bux, a grand makna, on whose head not so many days before I had seen seated one of the most lively tigers that I have had the pleasure of shooting. M.'s was on dear staunch old Lal Peeari, whose deeply scarred trunk bears testimony to her plucky encounters with the tiger tribe.

While crossing the river, I slipped the cartridges into my express and Westley Richard's No. 12, two of the best weapons out, and

as we ascended the opposite bank, eager were the looks in the direction of the village in possession.

Villages, by-the-bye, you do not find in this part of the country, that is not in the ordinary acceptation of the word; there are only small clusters of homesteads, two or three homesteads making a little hamlet. Several such hamlets, with the surrounding bamboo clumps, were scattered along the edge of the jungle near the river; close to one of them we saw some hundreds of people sitting and watching the deserted hamlet, *i. e.*, deserted by all but the tiger; this hamlet consisted of some four or five Bengali bharries, four or more mat-walled thatched houses, surrounding a small court-yard being the ordinary form of a bharrie.

Great was the excitement of the people as we came up, longing to be revenged on their enemy; bad enough they thought it to have a cow now and again carried off as it grazed near their homes; but for a tiger to leave the jungle and take up his abode in a village was rather too much, and they were eager to see him killed. As for his being in the little hamlet, of that they had no doubt; they had kept watch on all sides, and he could not have got off unseen.

Our *modus operandi* was quickly settled, a howda on opposite sides of the hamlet, the beating elephants around it. M. took up his position on the side we first approached, a likely looking gully between two houses taking his fancy as a natural line of retreat for the tiger if we turned him out; I went on the opposite side.

We first examined carefully all the cover around the hamlet, and satisfied ourselves that the tiger was not there, and that if anywhere, he was actually among the houses; the next thing was to search the hamlet itself.

Have you ever tried to get inside such a hamlet on an elephant? if not, you can have no idea how difficult it is. The overlopping roofs covering the passages between the houses leave little room for a man to pass, much less for an elephant to squeeze through, and if you do contrive to force your way into a court-yard, there is barely room in it for your elephant to turn round to get out again. Under such circumstances it took some little time before I could be certain that the tiger was not lying in any of the

court-yards or passages between the houses, and that if anywhere he must be inside a house. The question was which house? The khubberier, who was on one of the pads, could point out the shed in which the cow had been killed, but it was so hedged in with houses it was difficult to reach. I determined, however, to get to it, and to do this had to pull down some out-houses. M. meanwhile had taken up his post in front of the gully mentioned above, and was all prepared to let drive.

I could not have believed that mere matting, bamboo, and thatch could offer the resistance they did; but so it was, and it was with no little trouble that I got the elephant I was on to pull down the necessary sheds. What added to the difficulty was, that the elephant trained to respect house property could not understand the unwonted order to destroy. In doing this I could get little assistance from the pad elephants, whose mahouts, apparently sceating tigers behind every wall ready to spring on them, preferred watching outside.

At last the cow shed was reached; it was one side of a small court-yard, and it seemed highly improbable that the tiger was in it, as one or two pariahs lay peacefully in the yard basking in the sun, merely moving with their usual yelping accompaniment from one spot to another as we disturbed them; fowls were quietly perching about, and goats skipped joyfully as if in the most perfect security. The entrance into the cow shed being in a passage so narrow that I could not possibly get into it, I proceeded to pull down its outer wall; this done showed the cow lying dead with a wound in its throat, otherwise untouched, but there was no tiger! Then comes further search and more pulling down of sheds, but still no tiger! I was now convinced that the tiger must be in one of the dwelling houses, improbable as it appeared. These houses are raised on mud platforms from two to three feet high, some mud plastered mat walls and good strong chicks hanging outside their doors, and it certainly did not seem likely that a tiger would understand how to push aside a chick and enter a door. In vain I looked for any chick which showed signs of having been disarranged or forced out of its place. I had not wished to pull down any of these dwelling houses if I could possibly avoid it, but there was no help for it. So I deter-

mined to commence with a small sleeping house, one roomed, which was very near the cow shed; to reach this house another small shed had to be pulled down and the court-yard entered, one of the pad elephants had now joined me, and at last we were in that court-yard, side by side, the elephants' trunks touching the wall of the small sleeping house, their tails flapping against the house on the opposite side of the yard. The beating elephants now commenced to pull down the outer wall of this little house. I had tried leaning over the howda to look in through the chick. But the door was in an inner wall, not in the outer, and the little passage to it was too dark to allow of my seeing anything.

The elephant had great difficulty in getting hold of the outer wall to pull it down. You saw his trunk leech like feeling along the top of the wall and under the thatch roof searching for a hole or something to take grip of; at last he managed to insert his trunk just under the roof and to get it inside the house, but instead of pulling the wall down he commenced feeling all along the inner side; in vain the mahout, with words of endearment, curses, and blows urged the elephant to pull at the wall; he seemed to have made up his mind to make a perfect reconnaisance of the interior with his trunk before he would do anything else, and the house seemed so small that his trunk could almost reach into every corner. I remarked to my mahout that there could be no tiger in this house, or the elephant's trunk would not have got off scot free. At last appearing satisfied with his observation, the elephant seized the top of the wall and began to pull it downwards and upwards; this was followed by showers of dust, and surely the row was enough to arouse any live creature inside, and so it did—the chick moved, was pushed aside, and—out-sprung the tiger! Not a bit of it, out ran a little black goat!! A little goat instead of a tiger, and evidently afraid of nothing but the row we were making!!

The elephant now seemed to think he had done all that was needed, and the period not having as yet arrived when the lion and the lamb shall lie down together in peace, it certainly did not appear at all likely that a tiger would be alone in a room some twelve feet square with a goat and allow it to come out

alive—however, having commenced, there was nothing like going on pulling the wall down, and making all sure, so at it again went the elephant; behind the mahout on the pad sat one of the mahout's mates. I was too high above the top of the wall, the mahout a little too low to see well into the room as the elephant gradually brought the wall down: the mate was just about the right height, and kneeling on the pad eagerly did he strain his eyes into the seeming pitchy darkness of the interior of the room, but nothing did he see—a moment or two more and the elephant with a determined pull bent down the wall and pushing the upper bent half with his head, pinned it against the lower half so that a half wall only stood up; greater than ever was the dust as he did it, but just as he had got it well down the mate on the pad pointing into the room called out "there is the tiger." Hardly were the words on his lips, when clean out of the house, over the half wall and on to the beating elephants, leapt a magnificent tiger, such a leap, with loud angry roar, flaming eyes, and well extended jaws, showing his glistening ivory teeth—round flew both elephants. Maula Bux, had he been alone, would never thus have shown his stern to an enemy, but the other elephant swerving, elephant-like he followed suit; there was no bolting, the wall of the opposite house brought them up sharp. Long to describe, it was the work of a moment, and as we wheeled round I managed a flying shot—was there ever a more glorious opportunity for a flying shot—a flying tiger mid-air 'tween house and elephants. Our movements were, however, too rapid for accuracy of aim, as all those will understand who have experienced what it is to find yourself suddenly taken off your feet by the unexpected swerve of an elephant, and to feel yourself and rifles knocking about your howda in most unpleasing confusion. Still unsteady as our aim was, a miss was impossible with the huge beast only an inch or so from the muzzle of my rifle, and though nothing could have stayed him from bounding on the elephant's back, he did so with an express ball in his stomach, which so touched him up that though in his rage and agony he bit a piece clear out of the guddy within an ace of the mate's squat, he rolled off as quick as he was up, and slunk with a deep groaning roar between two walls; a second shot was impossible; he was out of sight before I could

have fired, even if I had regained my balance; the one shot had however done its business well, and doubtless saved the mate's life; a narrower shave could hardly have been possible. It was a moment of great excitement and such a sight—one not often seen too, a tiger leaping out of a dwelling house on to the elephant by your side!! M. unfortunately missed all this, only hearing the noise, as from where he was he could see nothing of what went on. He was right, however in his idea of what the tiger would do if ejected, as it had now slunk into the very gully up the mouth of which he was watching, but being a little way up the gully he could not sight it. I too could not see it, and from the nature of this case with the over-lopping roofs of houses on each side it was most difficult to get into any position from which you could do so.

Finding that the land in which the tiger now lay ran up some little way on my side, and was then blocked by a shed, I left the court-yard and had this shed pulled down. This done, my mahout could by stooping over his elephant's head just see the tiger; I was too high up to do so. We then backed till at last by leaning over the howda I could catch a glimpse of the dark outline of something which the mahout said was the tiger. It was difficult at first in the darkness of the gully to make him out, but my eye getting accustomed to it, I presently detected the heavy rise and fall of the dark mass; it was his painful breathing, and being sure that it was my friend, I let drive at what I supposed must be the position of his head. My elephant was steady as a rock, and the sudden start and angry growl told that the shot had gone home; still however his side heaved, so again I fired; he did not rise, but seemed to drag himself just out of my sight and by doing so showed himself to M., who was keenly waiting for him. A shot from M.'s rifle gave him his quietus.

Great was the rejoicing and loud the shouting as the inhabitants and those of the surrounding hamlets pressed in by hundreds to see their dead foe, and a noble beast he was; the tape was passed over him at once, and he was just over 10 feet. I may here observe with reference to the late discussion as to the length of tigers that I have shot many and good sized ones too, but I have never got one more then an inch or two over 10 feet. In fact, a 10-feet tiger is above the average size.

We went to see the small room in which the tiger had been so quietly ensconced, and found that he had been stretching himself on an old woman's bedding, the cotton stuffed pillow of which he had amused himself with tearing to bits; the goat being an interested and unmolested spectator all the time!!

After this we went to a neighbouring hamlet to see the man who had been mauled; we found it was a young fellow, whose curiosity prompted him to get a near view of a tiger, and who accordingly, when the inhabitants ran off leaving the tiger in possession, went back and climbed to the ridge of a roof whence he commanded a view of the cow shed in which at that moment the tiger was. No sooner was he on the top of the roof than the tiger spotted him, and with a spring was up by his side. Before the young fellow could throw himself off the roof the tiger's claws were in his right arm and the back of his head; the weight of the tiger however made the thatch give way, and while he slipped back into the court-yard the man fell back on the other side of the house and managed to get off. He was very badly wounded, and it seemed doubtful at first if he would live; however, we carried him into the station, and thanks to the skill of a clever surgeon, he was cured in a couple of months.

M. and I rode home well satisfied with the day's work. Mine had been the luck this time, but such is the chance of sports, it will be his next, though I fear his will be delayed, as his services being required in connection with famine in another part of India, he has left us, and when I last heard from him he told me that he often looks lovingly at his now idle guns, and thinks of the days gone bye.

Such dear reader is a day's tiger shooting, and if by chance you have never tried it, I can only say do so when you get the opportunity, and I know you will agree with me that it is the best shooting out.

R. M.

V. Extracts from Official Gazettes.

As the Editor has not received the Gazettes of Mysore, Assam and Madras, the following list will not be found complete :—

1.—Gazette of India—

Department of Revenue, Agriculture, and Commerce—Forests.

The 29th April 1875.—No. 504. *Mr. G. Stratford*, Sub-Assistant Conservator of Forests in British Burma, availed himself, on the 20th instant, of the furlough for one year granted to him in Notification No. 123, dated the 3rd February last.

No. 506. The Governor-General in Council has been pleased to promote *Mr. R. H. E. Thompson* in the Central Provinces from the 3rd to the 2nd Grade of Deputy Conservators, and *Messrs. R. S. Dodsworth* in Oudh and *E. McA. Moir* in Ajmere from the 2nd to the 1st Grade of Assistant Conservators, with effect from the 1st April 1875.

Mr. H. C. Hill, 2nd Assistant in the Survey Branch, is also promoted from the 3rd to the 2nd Grade of Assistant Conservators, with effect from the same date.

The 30th April 1875.—No. 522. *Messrs. A. E. Wild* and *G. A. Waters*, Assistant Conservators of Forests in the Punjab, are transferred to British Burma.

The 4th May 1875.—No. 534. *Mr. R. H. C. Whittall*, Assistant Conservator of Forests in the North-Western Provinces, is transferred to British Burma.

No. 550.—Erratum.—In Notification No. 506, dated 29th April 1875, promoting certain Officers of the Forest Department—

For—"*Messrs. R. S. Dodsworth* in Oudh and *E. McA. Moir* in Ajmere, from the 2nd to the 1st Grade of Assistant Conservators"

Read—"*Messrs. R. S. Dodsworth* in Oudh, and *E. McA. Moir* in Ajmere, to *officiate* in the 1st Grade of Assistant Conservators."

The 12th May 1875.—No. 560. *Mr. E. P. Dancy*, Assistant Conservator of Forests of the 3rd Grade in British Burma, is transferred to the North-Western Provinces.

The 17th May 1875.—No. 572. *Mr. A. P. Alymer*, Assistant Conservator of Forests of the 2nd Grade in Assam, is allowed leave of absence to Europe, on medical certificate, for one year.

The 27th May 1875.—No. 585. The services of *Moung-Poh Oh*, Assistant Conservator of Forests of the 3rd Grade in British Burma, are dispensed with from the 5th April 1875.

The 24th June 1875.—No. 659. The privilege leave of absence granted for one month to *Mr. A. P. Alymer*, Assistant Conservator of Forests, under Notification published in the *Assam Gazette* of the 17th April last having been cancelled, subsidiary leave for 12 days, from the 23rd April 1875 to the 4th May 1875, given instead, the Governor-General in Council has been pleased to allow the leave of absence on medical certificate granted to that officer for one year in the Government of India Notification No. 572, dated the 17th May last, to take effect from the 5th of that month.

No. 662.—*Major H. C. T. Jarrette, V.C., S.C.*, Deputy Conservator of Forests of the 2nd Grade in Mysore, is appointed to officiate from the 1st April last as a Deputy Conservator of Forests of the 1st Grade.

2.—CALCUTTA GAZETTE—

The 21st May 1875.—*Mr. A. L. Hume*, Deputy Conservator of Forests in charge of the Julpigoree Forest Division, is appointed to have charge of the Sunderbuns Forest Division.

Mr. E. Fuchs, Assistant Conservator of Forests, attached to to the Darjeeling Forest Division, is appointed to have charge of the Julpigoree Forest Division.

The 9th June 1875.—*Mr. A. L. Hume*, Deputy Conservator of Forests, in charge of the Sunderbuns Division, is promoted from the 3rd to the 2nd Grade of Deputy Conservators of Forest, with effect from the 1st April 1875.

3.—NORTH-WESTERN PROVINCES GAZETTE—

The 22nd March 1875.—No. 347. *Mr. L. A. W. Rind*, Assistant Conservator of Forests of the 3rd Grade in British Burma, is attached to the North Western Provinces as a temporary arrangement.

The 14th April 1875.—No. 10F. The two months privilege leave of absence granted in Notification No. 400F, dated 1st December 1874, to *Mr. O. Greig*, Sub-Assistant Conservator, Jaunsar Division, is hereby cancelled.

The 23rd April 1875.—No. 122F. With reference to Notification No. 43F-C, dated 10th instant. *Messrs. W. R. J. Brereton*, Officiating Deputy Conservator, 3rd Grade, and *R. H. C.*

Whittall, Assistant Conservator, 2nd Grade, respectively, made over and received charge of the Dehra Doon Forest Division on the afternoon of the 6th idem.

The 8th May 1875.—No. 63F-C. The services of *Mr. R. H. O Whittall*, Assistant Conservator of the 2nd Grade, are placed at the disposal of the Government of India, Department of Agriculture, Revenue and Commerce.

The 14th May 1875.—No. 133F. *Mr. W. R. J. Brereton*, Officiating Deputy Conservator of Forests, embarked at Bombay on the 19th April last, on the leave granted to him in Notification No 43F-C., dated 10th idem.

The 28th May 1875.—No. 158F. With reference to Notification No. 116F., dated 19th April 1875, *Mr. L. A. W. Rind*, Assistant Conservator of Forests, 3rd Grade, joined the Jaunsar Division on the afternoon of the 3rd idem.

The 16th June 1875.—No. 173F. With reference to Government of India Notification No. 534, dated 4th May 1875, *Mr. R. H. O. Whittall*, Assistant Conservator, 2nd Grade, and *Mr. J. E. O'Callaghan*, Officiating Deputy Conservator, 1st Grade, respectively, made over and received charge of the Dehra Doon Forest Division on the forenoon of the 1st June.

—PUNJAB GOVERNMENT GAZETTE—

The 4th June 1875.—No. 180F. *Mr. J. O. McDonell*, Assistant Conservator of Forests, Fuel Reserve, Northern Division, is appointed to the charge of the Fuel Reserve, Central Division, *vice Mr. A. E. Wild*, transferred to Burma, with effect from the afternoon of the 15th May 1875.

No. 181F.—*Mr. C. F. Elliot*, Assistant Conservator of Forests, Rawalpindi Division, is appointed to the charge of the Fuel Reserve, Northern Division, in addition to his other duties, with effect from the forenoon of the 13th May 1875.

No. 182F.—*Mr. F. O. Lemarchand*, Assistant Conservator of Forests, Lower Jhelum Division, held charge of the Fuel Reserve, Northern Division, from the 8th to the 12th May 1875, both days inclusive.

5.—OUDH GOVERNMENT GAZETTE—

The 15th May 1875.—No. 1594. *Mr. J. C. Lensonby*, Officiating Deputy Conservator of Forests, Bahraich and Gonda Division, is granted three months privilege leave of absence from the 15th June 1875, or from any subsequent date from which he may avail himself of it.

6.—CENTRAL PROVINCES GAZETTE—

The 31st March 1875.—No. 1131. *Mr. J. McKee*, Assistant Conservator of Forests, rejoined from the privilege leave granted to him in Notification No. 803, dated 5th instant, on the 24th idem.

The 26th May 1875.—No. 1844. The following Assistant Conservators of Forests in the Central Provinces are promoted by the Chief Commissioner from the 3rd to the 2nd Grade, with effect from the 1st April 1875:—

MR. W. P. THOMAS.
MR. G. H. FOSTER.
MR. J. MCKEE.

The 10th June 1875.—No. 2037. Two months' privilege leave of absence is granted to *Mr. H. Leeds*, Deputy Conservator of Forests, Western Division, from the 1st August next or the subsequent date on which he may avail himself of it.

No. 2038.—Three months' privilege leave of absence is granted to *Mr. W. P. Thomas*, Assistant Conservator of Forests, from the 1st proximo or the subsequent date on which he may avail himself of it.

7.—BRITISH BURMA GAZETTE—

The 20th May 1875.—No. 9. With reference to *Gazette of India* Notification No. 522, dated 30th April 1875, *Mr. G. A. Walters*, Assistant Conservator of Forests, reported his arrival in Rangoon on the 14th instant.

8.—BOMBAY GOVERNMENT GAZETTE—

The 27th March 1875.—*Mr. Hewette*, Assistant Conservator of Forests, Kolaba, is allowed privilege leave of absence for three months from the 1st April 1875.

The 30th March 1875.—*Mr. C. A. Morphew*, Assistant Conservator of Forests, Satara, is allowed leave of absence for one year, to proceed to Europe, on medical certificate, under Section 3, Supplement F. of the Civil Leave Code, second edition. He is also allowed subsidiary leave, not exceeding 30 days, under Section 10 of the said Supplement.

The 3rd April 1875.—*Mr. C. A. Morphew*, Assistant Conservator of Forests, 2nd Grade, resigned charge of the Satara District Forests Office on the 11th March 1875, after office hours, and *Mr. A. F. Shuttleworth*, Conservator of Forests, Northern Division, assumed charge thereof.

The 20th April 1875.—*Mr. J. M. Campbell*, Conservator of Forests in Sind, is allowed special leave of absence, under Section 15 of the Civil Leave Code, for six months from such date in May next as he may avail himself of it, to proceed to England on urgent private affairs, and subsidiary leave for 20 days' under Section 18 of the Leave Code.

Mr. W. S. Hexton, Assistant Conservator of Forests, 1st Grade, is appointed to act as Conservator of Forests in Sind during the absence of Mr. Campbell on six months' special leave.

The 21st April 1875.—*Mr. W. J. O. Dunbar*, Assistant Conservator of Forests, Northern Circle, is allowed one month's privilege leave of absence under Section 21 (a) Chapter VI of the Civil Leave Code.

The 19th April 1875.—*Mr Hewett*, Assistant Conservator of Forests, 2nd Grade, delivered over charge of the District Forest Office, Kolaba, on the 8th instant, after office hours, to Mr. G. Whitworth, C.S., 2nd Assistant Collector, who assumed charge thereof.

The 23rd April 1875.—*Mr. R. Courteney* and *Mr. W. J. Dunbar*, Assistant Conservators of Forests, Northern Division, passed their examinations in the Hindoostani and Guzerati languages respectively on the 19th instant.

Mr. Courteney to be Supernumerary Assistant to the Collector of Surat.

The 8th May 1875.—*Messrs. G. Whitworth*, Acting 2nd Assistant Collector, and *A. Crawford*, Acting Collector of Kolaba, respectively delivered over and received charge of the office of the Assistant Conservator of Forests, Kolaba and Dapuli, on the 16th April 1875 after office hours.

The 15th May 1875.—*Mr. Dunbar*, District Forest Officer, Northern Circle, gave over charge of his duties to Mr. Trevor, Extra 1st Assistant Collector, on the 7th April, after office hours, and proceeded on examination leave, which lasted up to the 19th idem; and from the 20th April Mr. Dunbar availed himself of the privilege leave sanctioned to him in *Government Gazette* of the 22nd April 1875, page 299.

The 24th May 1875.—In suppression of Government Notification of 3rd March 1875, *Mr. Betham*, Assistant Conservator of Forests, Dharwar, was allowed privilege leave of absence from the 14th idem to 14th ultimo, both days inclusive.

The 19th May 1875.—*Mr. Shuttleworth*, Conservator of Forests, Northern Division, delivered over, and *Mr. W. J. Dunbar*, Assistant Conservator of Forests, 3rd Grade, received charge of the Satara District Forest Office on the 17th May, before office hours.

The 2nd June 1875.—The appointment of *Mr. Wallinger* to be Deputy Conservator of Forests, 3rd Grade, notified at page 212 of the *Bombay Gazette* of 4th March 1875, is to have effect from the 13th February last.

The 31st May 1875.—*Messrs. Narayen Ballal Oke*, Sub-Assistant Conservator, 1st Grade, and *W. H. Horsley, C. S.*, respectively delivered over and received charge of the District Forest Office, Khandesh, on the 21st instant, after Office hours.

The 8th June 1875.—*Mr. Dunbar*, Assistant Conservator of Forests, having assumed charge of the Satara District Forest Office on the 17th ultimo, the expired portion of the one month's privilege leave of absence granted to him from the 20th April 1873 under Government Notification of the 21st idem is cancelled.

The 1st June 1875.—*Messrs. A. T. Crawford*, Acting Collector of Kalaba, and *Narayen Ballal Oke*, Sub-Assistant Conservator of Forests, 1st Grade, respectively delivered over and received charge of the Office of the District Forest Office of Kalaba and Dapuli on the 25th May 1875, after office hours.

The 3rd June 1875.—*Messrs. A. C. Trevor*, Acting Extra 1st Assistant Collector, Panch Mahals, and *T. B. Fry*, Assistant Conservator, 3rd Grade, respectively delivered over and received charge of the District Forest Office, Northern Circle, on the 31st May 1875, before office hours.

The 2nd June 1875.—*Mr. E. J. Ebden, C. S.*, assumed charge of his duties as Special Officer employed in the selection and demarcation of Forest Reserves in Kanara, before office hours, on the 27th January 1875.

INDIAN FORESTER.

Vol. I.] OCTOBER, 1875. [No. 2.

The Darjeeling Forests.

By J. Sykes Gamble, B.A.

Byron's Lines,

> There is a pleasure in the pathless woods,
> There is a rapture by the lonely shore,
> There is society where none intrudes
> By the deep sea with music in its roar,

were written when the author was sunning himself on the smiling shores of the Adriatic, looking over the blue waves at the bluer skies overhead, and meditating on the future of Italy, but though perhaps we have most of us in this country little to talk about the lonely shores which can rarely excite else than the desire to cross them to revisit our friends; yet to a lover of scenery, a lover of nature in general, and to the lover of vegetation, and that tree vegetation in particular, there are few scenes so attractive, few places where solitude is less felt than in the vast luxuriant semi-tropical forest of the N. E. Himalaya.

Sikkim and Bhutan are well-known names to those who have looked over old forest records, or studied the plant collections of Hooker and Wallich and Griffith, but there are few who have had the privilege to explore the deepy alleys filled with strange vegetable forms, serpent-like lianas, trees of monstrous size and shape, perhaps clothed with the fairy blossoms of epiphytic orchids or the delicate tracery of pendent ferns to mount thence upwinding paths through dark forests whose only colour is that of the mossy hangings of the gigantic stems or the occasional flower of the scented magnolia to the regions of winter snow where masses of Rhododendron cover with their gorgeous tints the slopes of the upper hills and twist in every conceivable shape their wonderfully-coloured limbs. There are in fact in India few places where such an exuberance of vegetation,

such a wonderful series of forest forms are to be found than in the forests of British Sikkim and Bhutan. There is to be found nearly every possible kind of forest from the dense-growing straight-stemmed sal of the plains to the massive trunks of the chestnut and oak in the temperate regions, the Rhododendrons birch, alder and whitebeam of the cold climates and the pine forest of the almost perpetual snow. The forests of the Darjeeling district—not those under the Forest Department, although it too possesses specimens of most kind—but the forests, in general, are more varied probably than those of any other district in India. As the soil varies or the hill slopes are more or less protected from the sun or from the rain, a different vegetation is always to be seen—but always interesting—everywhere producing some new form, but always interesting to the forester or the botanist.

Proceeding to our examination of the different kinds of forest met with in this district, it will be best first to explain how the district is situated and how it happens that in such a small area (1,010 square miles) so many varied kinds of forest are met with and so many species of tree. If we look at the map of Bengal and follow from the sea in a northerly direction the courses of the Ganges and Brahmaputra, we notice at once that between those two rivers, stretching right up to the foot of the Himalaya, is a vast tract of fertile level plain; that directly we pass to the west of the Ganges at its turn near Rajmehal we find the Sonthal Hills, and to the east of the Brahmaputra near its turn towards Goalpara the Garrow Hills, both forming a sort of guardian pillars of Hercules to the plains between. Up these plains then travels the raincloud, to drop its burthen on the first slopes of the Himalaya in the districts of Darjeeling and Julpigori. There are few finer sights than to stand on the lower hills about Pankabarry or Choonbutty (higher up the mists encumber the view) and watch the rainclouds sweeping up from the Bay of Bengal to discharge their contents on the Darjeeling hills. The Darjeeling district proper consists of a high range of hills, offshoots of the great group of Kinchinjunga so long esteemed the highest in the world and even now only reduced to second eminence by a not far distant

neighbour; then to the east, the deep valley of the Teesta, and beyond that another high group springs from the Choea range, which goes off southward half way between the lofty peaks of Chumalari and Donkia. Thus our raincloud, travelling northwards, strikes first on the rugged precipices on either side of the Teesta and penetrates up that valley, and those of its smaller neighbours; the Balasun, Mahanuddy and Juldoka, dropping its watery burden as it goes. In front of the hills, and stretching down southwards for a distance of about 10 miles, lies the Terai. We have thus several zones of altitude which present different features of vegetation.

The rainfall of the district is rather variable. In some parts it falls heavier than in others; thus there is always less rain in Darjeeling than at Sonada or Rungbee. The average rainfall at Darjeeling amounts to 125 inches.

The rain chiefly falls in the months of June, July, August and September, and there is little in November, December, January, February and March.

The mean temperature at Darjeeling is 55°, monthly average, highest 64°, lowest 41°.

The front face of the hill-region is almost invariably steep, and more especially so in the eastern hills, where some of the rivers, in a course of at most 10 miles, make a descent of 10,000 feet.

Besides the Teesta and its feeders, which form almost the whole of the northern boundary and meeting in the middle pass southwards through the district, the chief rivers are—

The *Mechi* on the Nepal frontier;

The *Balasun*, a large impetuous river, which in the rains often does immense damage by the piles of drift and enormous boulders which it brings down;

The *Mahanadi* draining the lower hills to the south of Mahalderam;

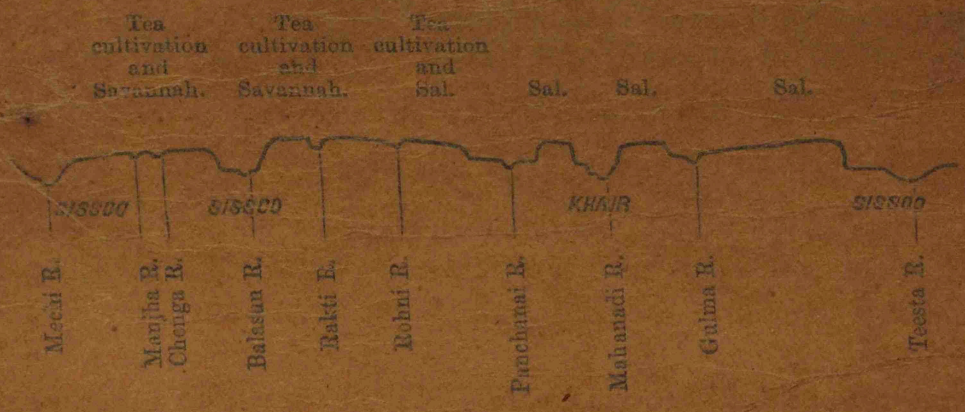
The *Chel*, the *Neora*, and the *Murti* draining the eastern hills; and

The *Jaldoka* on the Bhutan frontier.

The highest mountain is *Phulloot*, 12,336 feet, after which are Sundukpho, Suburkum, Reelee La, Tongloo, Senchal

and Punkasary, the latter two being, it may be said, the centres respectively of the western and eastern hills.

On proceeding northwards from the plains towards the hills, and after leaving the rice fields, a gentle slope is ascended leading up to the base of the lower spurs, a slope covered with forest or with the clearances made for tea-cultivation. This slope is due to the sandy deposits of the numerous rivers which now cut through them again, so that their banks are invariably marked by steep ridges reaching up to nearly 400 feet in height in places, so that a section drawn across the Terai presents pretty much the appearance in the figure. Between the rivers and the first ridges are generally patches of sissoo and khair forest; at the foot of the ridges themselves are often bands of evergreen swamp forest,



while above, the ridges are occupied either by sal forest, or savannah tracts. These we will now proceed to describe in detail.

The distribution of the forests.

Formerly, there can be but little doubt, the greater part of the district was forest, and even now the proportion is very large, though the forest area is rapidly diminishing through the extension of tea-cultivation in the plains and the western hills, and the settlement of Bhuteas and Nepalese towards the east. The different kinds of forest are many and varied, and we will now attempt to describe them *seriatim*.

1.—*Sal forests* occupy the better-drained portions of the Western Terai, the front face of the lower hills up to about 2,500 feet from the Mechi River on the west to the Chel River at Dalingkote and the valleys of the Teesta, Rungeet and Rungpo

on either side, almost continuously from the plains as far as the frontier of Sikkim.

2.—*Sissoo forests* occupy merely the low ground on the banks of the rivers often mixed with khair.

3.—*Savannah forests* are the grass tracts with occasional trees, or forest predominating in neither sál nor sissoo, chiefly found in the Western Terai.

4.—*Mixed forests* occupy the greater portion of the district up to an altitude of 6,000 feet; they may divided into—

1*st.*—*Mixed Plains Forest.*—Of these there are not many examples, with the notable exceptions of the Dulka Jhar in the west, and almost the whole of the Eastern Terai, though in consequence of its little value this is generally classed as savannah. Occasionally also patches are found at the bases of the ridges, and notably we can cite the 'Singaree Pahar' forest near the Teesta.

2*nd.*—*Lower Hill Forest* covering the whole of the Hills up to an elevation of 3,000 feet, with the exceptions of the sal tracts.

3*rd.*—*Middle Hill Forests* between 3,000 and 6,000 feet elevation; of this there are now very few examples west of the Teesta, though east of that river it is perhaps the most valuable of the forests.

5.—*Temperate forests* cover the hills above an elevation of 6,000 feet. We may distinguish them as—

1*st.*—*Oak forests*, in which the prevailing trees are the oaks, chestnuts and magnolias; they cover all the high spurs between 6,000 and 8,000 feet.

2*nd.*—*Rhododendron forests* appear above 8,000 feet, chiefly in Tonglo and Reehçe La, but at about 11,000 feet are replaced by

3*rd.*—*Fir forests* only found in the Singalelah ridge, from Sundukpho to Phullcot 12,000 feet.

SAL FOREST.

1*st.*—*Sal Forest in the Terai.*

There can be little doubt but that formerly the sal tree covered nearly the whole of the more elevated and drier parts of the Terai. It is now, however, chiefly restricted to the sandy ridges between the Balasun and Mechi Rivers, and

between the Mahanadi and the Teesta. But there is this difference—that whereas the sal forests in the latter tract lie under the hills and rarely reach further from it than 5 miles, those in the former only begin at that distance from the hills and stretch on down almost to the extreme south of the district; these western forests differ also materially in constitution from those towards the Teesta, so that while the Teesta forests, owing to extensive fellings, have been in many places almost entirely replaced by long grasses, in the western ones the long grass is scarcely known, and the sal comes up almost pure in myriads of seedlings wherever a little light is opened out to the soil. The general appearance of many of the Western forests is that of being regularly worked by the system of natural reproduction, where the seed, secondary and final cuttings have all been heavy, though naturally it is too much in patches for the application of anything like a ready-made working plan. These forests cover ridges, and are surrounded by cultivation, and it is remarkable that in many places where the cultivation has been stopped and the land allowed to lie fallow a dense crop of young sal has immediately grown up. Where the seed comes from is a mystery, as it is not of a kind easily transported by the wind, but the fact remains. Of other species of tree there are few, except that as the sal gets older it seems to associate itself with other kinds, and particularly the *Dillenia pentagyna* and the *Terminalia chebula and belerica*. The undergrowth is really dense, and in it is often seen the curious *Cycas circinalis*, which, though very common in many parts of India, is not so in the Darjeeling district. These forests could easily be put under a systematic working plan and reproduced naturally, but unfortunately very few of them are now in the hands of Government.

Turning to the Teesta forests the conditions are quite different. When trees are felled—instead of the fine mass of young seedlings already described long grass comes up thicker and thicker. But this even would make little difference, as the sal seedlings, or rather, in most cases, the shoots of sal described by Mr. Baden Powell, at page 67 of the 1872-73 report, show no objection to

coming up with the grass; if there were no such thing as jungle-fires to make a clean sweep, year after year, of all low growth, and to torture into every conceivable shape of gnarled and twisted ugliness, the few wretched remnants of the old virgin forest. This is very particularly noticed in the large private forest of Bykantpore, south of the Government reserves, which, though actually in the district of Julpigori, geographically belongs to the Terai portion of the Darjeeling district. This forest, said formerly to have consisted of fine large sal, has been worked to such an extent, that only two years ago every tree fit to give a small 'bully' of 2 feet girth was cut out, and that now, instead of reproducing itself, it cannot fail to deteriorate year after year, till at last, though the soil is scarcely suitable, it will either be put under cultivation or kept as a perpetual grazing ground. Some parts of the Government reserve are not much better, and the experiments on the making of firepaths to keep out fires have all failed, but as a better supervision is kept up and greater punishments are inflicted on people found igniting the forest, now than heretofore, it is to be hoped that in a short time we shall be able successfully to strive against fire and grass, and again send into market sal timber of the fine description of the old trees cut down in the wasteful times before forest conservancy was thought of, and which, unfortunately, are still by no means remote in Bengal.

The general appearance of the Teesta Terai sal forests is very variable; towards the boundaries the aspect is chiefly that of a vast expanse of long grass, dotted with a few sal of stunted and unhealthy growth, a few big-leaved *Dillenias*, the white-stemmed *Eugenia obovata*, and the scarlet-flowered *Butea*. If, however, we examine the ground, we find almost always large numbers of seedlings or stump shoots. The grass gradually disappears as the forest improves, and the older portions, the tall stems of the sal trees growing barely a few feet apart, their monotony occasionally relieved by the gigantic leaves and twisted stems of the *Dillenia*, the gouty-looking trunks of the *Sterculia* with its bright coloured red pods, the scaly bark and ashy foliage of the *Lagerströmia parviflora*, and last, though not least in importance, the serpentine folds of the gigantic creepers the

Bauhinia Vahlii and *Spatholobus setaceus*, throwing their arms in graceful curves from tree to tree, and supporting thus in the hollows of their bends an occasional bright-flowered orchid or pendent *Hoya*, have a fine appearance though scarcely to be surpassed with the tropical luxuriance of the Lower Hill valleys or the majestic grandeur of the upper ridges.

In these older portions there is very little undergrowth; a few seedlings, but rarely of sal, as that seems to thrive best wherever a little light is admitted; and in the rainy season a dense crop of *Leea*, which however all dies down at the beginning of the cold weather. As for the working plan, until the forests have a little recovered it will scarcely be required, though the data are ready for its preparation, but a few points will have to be remarked, *viz.*, that the seed cutting will have to be very slight, and in general confined to the extraction of the less useful trees, the extraction of the material cut done quickly and immediately before the seed time, that is, in April and May, and curtains of protection left on the boundary lines and along roads to preclude any possibility of fire.

2nd.—The sal forests of the Lower Hills and Valleys are quite different again. They generally occupy the ridges towards the plains or the rivers, and have always a finer and more healthy growth than the plains sal forest. The general appearance of these forests is also very different; there we rarely find any of the long grass which characterizes the greater part of the Terai forests. This is replaced by a short wiry bamboo-like grass '*Pogonanthera*,' or in the more exposed places by a tall stiff species of '*Erianthus*.' The sal generally occupies the warm slopes towards the plains or the river, and its general growth is very quick. It grow straight and tall, and rarely branches till after 50 or 60 feet from the ground. The sal is not usually a handsome tree, but few trees have a finer appearance than a very old straight grown sal of the Rungeet Valley—with its lofty deeply-furrowed stem, irregular spreading branches and short crown—recalling the appearance of the fine Scotch fir of Strathspey, the old spruces of the Jura, or the larches of the valley of the Inn. The young forests are dense and closely

grown, and differ from the Terai sal in the thick almost gouty appearance of the young bark. These forests will not be difficult of management under a working plan, as the danger for fire, though still by no means to be neglected, is very much less than it is in the Terai. In describing the distribution of sal in the Lower Hills, we will commence, as usual, from the west. Between the Mechi and the Balasun there is little old sal, though the charred and blackened trunks, so commonly met with, and the fine young growth on the warm ridges, shew that there is little doubt that formerly these hills were covered with trees as fine as are now met with in the more or less inaccessible upper valleys of the Rungeet and Rungpo. East of the Balasun there is little sal till we reach the Rohoni River, except a few fine old trees on the west of the Bamunpokri spur, but east of the Rohoni, away to the Chel River for a distance in a straight line of 20 miles, is an almost unbroken forest, the ridges covered with sal alternating with deep valleys filled with the various tropical forms of the evergreen forests, conspicuous among which tower the gigantic *Terminalias*, with *Cedrela*, *Schima*, *Duabanga* and *Bombax*, and thousands of smaller trees of every possible kind. East of the Chel River the sal appears to cease, and it is a curious fact that it is also at this point that the only gap in the line of Tertiary formation along the Himalayas from, as stated by Mr. Mallet,* "the Indus to the Brama Khund" is found. Turning to the valley forest there is little but sal on all the drier slopes of the Teesta valley, and the tree penetrates to the west up the Rungeet and Rumaun, and to the east up the Rungpo and Rushett, in the whole of which long line it is almost universally found up to an altitude of about 3,000 feet. But it is a very curious thing that except just at the mouths of the Reyang and Rilli sal is rarely, if ever, found in the lateral valleys, and almost never in those of the Balasun, Mahanadi, and Juldoka. The finest blocks of sal forest are undoubtedly those at Reyang and Rilli, and these are the more accessible. The forests of the Rungpo are also very good, and are now under examination. The sal of the Rungeet is also very fine,

* Memoirs of the Geological Survey of India, Vol. XI., Pt. 1.

and while speaking of it we can notice that on the Sikkim side of the river it grows almost everywhere mixed with the '*Pinus longifolia*,' while on the Darjeeling side there is only one solitary patch of about 200 acres containing this mixture. This is due to the fact that the '*Pinus longifolia*' will scarcely grow except on a due southern slope, where it is constantly under the direct rays of the sun, while the rainfall of the front of the Himalayas is too great. This forest satisfies this condition, as it lies at the mouth of the Rungnoo River running straight northwards from a little above Darjeeling. The growth of the pine is handsome, but not so fine in British as in Independent Territory. Its wood is not much used, though some of the oldest Darjeeling houses are said to have been built of it, and that it has never required renewal.

The sal forest of the Darjeeling division, which are under Government, form the chief source of the Forest Revenue of the division, and the greater portion of this revenue is derived from the supply of Public Departments, such as the Public Works and the Northern Bengal State Railway. The timber is worked out in log by departmental agency for the most part. The forests of the part of the Lower Hills accessible to elephants, and those of the Terai, have been so much worked formerly that almost complete rest will be required to put them in proper order and make them what they should be—the suppliers in conjunction with the Julpigori forests of the sal trade of Lower Bengal. In the vallays there is still a large quantity of mature timber, and artificial improvements have so improved the Teesta River that logs can now be floated with very little loss from the upper forest to the depôt at Julpigori, the most important and most central point of Nothern Bengal, as being situated on a fine floating river and as the terminus of the Northern Bengal State Railway.

Sissoo Forests.

Of sissoo forest the extent is very small, as not only are the forests confined exclusively to the banks of the rivers, but they are rarely sufficiently pure, as we shall see in taking them in order.

The Mechi and Balasun forests are, scarcely speaking, true sissoo forests, as the sissoo is so intermixed with other species as rarely to be even the prevailing tree, and justify the name. Of the other trees the commonest are *Acacia catechu*, *Albizzia elata*, *Bombax malabaricum*, *Nauclea cordifolia*, *Garuga pinnata*, while the very slight undergrowth is chiefly formed of prickly climbing *Acacias*, and an occasional shrub of *Capparis*. In the rainy season the water generally floods these forests, so that the seedlings are usually washed away before they have time to fix themselves firmly in the loose sandy soil. The sissoo is generally of large size, and is tolerably straight in stem; it is in great demand about Nuksurbarry for export to the Purneah district for the manufacture of cart wheels. Proceeding eastwards there is very little, except a small strip on the bank of the Rakti, which chiefly consists of "sissoo," "khair," and the white "siriss," and which is capable of being easily reproduced naturally; until we reach the Mahanadi. This river is bordered for about five miles along its western bank with a dense forest of "khair" and sissoo in the proportion of two of the former to one of the latter. This forest is very interesting; it rises in steps from the bed of the river. Each year some new piece seems to be left dry by the water and is immediately covered with a dense crop of young khair and sissoo, while the plateaux, as they ascend, hold older and older forest, the last containing almost entirely old trees with little or no undergrowth. This forest could adapt itself undoubtedly to a working plan under the system of natural reproduction, and although at present khair is of very little value in Bengal, as the extraction of cutch is not practised, yet, with the approach of the Railway with whom its timber would be valuable for sleepers and for fuel, such forests as these will deserve a very careful systematic working under that method. Of this kind of forest there are about 1,000 acres only, of which nearly 600 are Government Reserve, the remainder belongs chiefly to planters, who make charcoal of the trees. Eastward of this—with a few exceptions near Sivoke—the khair disappears, and in the small sissoo forests, which line the Teesta, Chel, Murti, and Jaldoka, the sissoo is

always pure, though rarely of any size, and scarcely covering large enough areas to deserve notice.

The present demand for sissoo is chiefly for cart wheels for the carts used on the Ganges—Darjeeling Road; but were carriage cheaper, there can be little doubt that it would sell well in Lower Bengal for furniture and house-fittings.

Savannah Forest.

This will require but little notice. They are generally large tracts of long grass with here and there a tree, generally of species not usually in request. Of the trees which are found in these tracts the most common is the Palass, *Butea frondosa*; the *Dillenia pentagyna*, *Eugenia obovata*, and two species of *Randia* make up the usual vegetation of the true savannahs, where the grass grows high over the back of the elephant you ride, and in the dry season, after the annual fires have swept fiercely over it, serves for the grazing of herds of buffalos, brought up from the plains of Bengal to seek the short rich young shoots which are so fattening. To describe the distribution of these savannah forests would be difficult, as they are usually found interspersed with patches of good forest. A kind of forest, which, though stocked with timber, must really be classed savannah, is that often called "creeper jungle," where the vegetation consists of small trees of stunted growth intertwined with innumerable creepers, among which we may chiefly remark the blue-flowered *Pueraria tuberosa*, the *Entada scandens* with its curious quadrangular stems, and the thorny *Acacia pennata* and *Intsia*. The commonest small trees are *Callicarpa arborea*, *Kydia calycina*, and *Calosanthes Indica*; but they rarely reach a size which would make them of any value. The only trees with wood of any use, which are occasionally found in these tracts, are the *Cedrela Toona*, *Dalbergia latifolia* (which however rarely grows to any size), and *Acacia ferruginea*. These tracts are those usually selected by the Mechis, the wandering tribe of the Terai forest, for their cultivation, and are chiefly put under cotton, which, though rarely of good staple, yet

seem to thrive wonderfully in the black mould given by the soil of forest undisturbed for such a long time.

These creeper savannahs are very noticeable between the Mechi and Balasun, wherever they have not been taken up for tea cultivation; they are very well seen along the old road to Darjeeling by Punkabarry; they cover a large tract of land towards the Mahanadi River; and most noticeable of all, they occupy the whole of the Eastern Terai, east of the Chel River, with the exception of the reserved forest between the Murti and Jaldoka Rivers. The Eastern Terai savannah is very curious in the absence of long grass, which is replaced by a dense thicket of small shrubs all closely bound together by innumerable wiry creepers chiefly *Convolvulaceæ*. There, occasionally, a gigantic timber tree, such as the *Duabanga*, lifts its head over the dense undergrowth; the numerous streams run in pebbly channels overhung with a continuous arch of moisture-loving trees, and the only means of penetrating the forests is along the rough paths cut by the Mechis from patch to patch of their cotton cultivation; or, in the northern parts, along the tracks made by the wild elephants and buffalos, in their travels from feeding ground to feeding ground.

Mixed Forests.

Plains.—Of this there is not very much, as already noticed, as we have described the greater part of the Eastern Terai under 'savannah.' This kind of forest is often called 'Evergreen Forest;' but this, though a very true term in certain cases, is scarcely applicable in all, as the best definition of mixed plains forest is 'forest of different species of timber trees of value in which neither sal nor sissoo sufficiently predominate as to give their name to them.'

The 'Dulka Jhar is a large tract of about 4,000 acres, of which about 1,000 may be said to be 'sal forest,' and the rest mixed. It contains most of the ordinary evergreen trees, but chief among them the "*Chilauni*" *Schima Wallichii*, a large tree with a good timber which has lately come much into use. To attempt to describe the different species of tree growing in such a forest would be a work of some difficulty,

as the number of them is so enormous, but besides *Schima* we may mention as useful trees the *Terminalia tomentosa* and *myriopteron*, *Artocarpus chaplasha*, and *Cinnamomum glandulifèrum*. Figs are exceedingly numerous, especially-*Ficus Bengalensis* and *cordifolia* and the India-rubber tree is said to exist, though it is somewhat doubtful whether it is the true *Ficus elastica*. The ground is almost always swampy and the undergrowth is chiefly formed by a dense cane brake, the common species of cane being the *Cymbospathes Jenkinsianus, Griff*,* which is much sought for for the innumerable uses to which canes are put in the Himalayas.

It is difficult to give an idea of the luxuriance of the vegetation of such forest as this, and (still better) the Singaree Pahar forest near the Teesta. A swampy ground difficult to walk over covered with a dense growth of curiously shaped ferns; ground orchids—especially notable among which are the tall grass-like but gorgeously-flowered *Arundina*, the *pyramidal Cyrtopera* and *gigantic Araideæ*; then the twisted quickly stems of the different canes climbing up trees whose trunks are clothed with epiphytic orchids and graceful climbing ferns, and whose foliage and flowers it is difficult to discern, so dense is the tangled growth. To cut a path through a forest of this description is no easy task. Even the active Nepalese, with their curved 'kukie' or the jungle-living Lepcha, with his straight heavy-loaded 'ban,' can only with great patience and perseverence force their way through the tangled thorny masses of the cane stems. Now and then, in these forests, we meet with gigantic specimens of forest trees, with huge buttressed trunks and branches far away in the air above the lower level of the smaller surrounding trees; such are the Banj, the *Echinocarpus sterculiaceus*, a huge tree with large prickly chestnut-like fruits, the numerous figs, the giant "Semul" *Bombax malabaricum* or the *Terminalia myriopteron*: conspicuous in all the swamps is the red bark and huge apple-like fruit of the *Dillenia Indica*; the *Eugenia formosa* with its broad leaves and clusters of tassel-shaped pink flowers, and the *Pterospermum acerifolium*, whose down is considered an invaluable specific in

* Anderson's Enumeration of the Palms of Sikkim Linnean Society's Journal, Vl. XI. No. 49 of 9th April 1869.

stopping bleeding and healing wounds. One great drawback to the beauty of these forests, however, is the swarm of small insects who haunt the swampy parts, and, especially in the hot season, almost interdict their entrance; another is that at the season when the vegetation is at its greatest luxuriance and beauty, in the rains, it is almost impossible to go through them, even on an elephant.

As for the management of such forests, it is difficult to say how they should be worked, but probably the only plan will be that of cutting a certain number of mature trees every year, if possible, by departmental agency.

Turning to the Eastern Terai, we have already noticed the Savannah parts, and we have only left the Murti—Jaldoka Reserve, which is of a totally different description to the mixed forest of the west. This is a forest of big timber, chiefly "Chilauni" *Schima Wallichii*, with many *Lagerstræmia parviflora*, *Dillenia pentagyna*, *Eugenia Jambolana*, and a few sal and toon, besides other trees. The whole forest is of old timber and has little or no undergrowth; it could be easily put under a systematic working plan, and is probably capable of amelioration by the gradual introduction of sal and toon in the cuttings. The Chilauni germinates freely wherever there is open ground and light cover; sal the same, so that it will be easy to arrange the cuttings. The seed cutting will have to be tolerably heavy, but a large number of Chilauni should always be left sufficient just to give a complete cover. The second and final cuttings will, of course, depend on the fulness of the germination. The northern is the older part, and the first affectation should there be made; there will also then be less danger for the incursion of grass.

Lower Hill Forest, or the forest from the level of the plains to 3,000 feet, occupy the whole front of the hills and penetrates into the valleys. Although we have described parts of these forests under the head of sal, yet properly, the sal of the front face of the hills should be classsed as 'Lower Hill,' as it is impossible to make, for working plan proposes, such a minute distinction as would be necessary if they were separated.

Between the Meehi and Balasun the Lower Hill Forests have been much spoiled by old cultivation, with the exception of 'Lohagarhi' an isolated hill covered with fine timber, principally 'Saj,' *Terminalia tomentosa.* East of the Balasun we first find the Bamunpokri Plantation Reserve, the upper plateau of which almost entirely resembles the Murti—Jaldoka Forest in its general age and in the prevalence and fine growth of 'Chilauni;' but the slopes of the hill are often covered with dense bamboo thickets (*Dendrocalamus*) which yield a large yearly revenue and which must be carefully protected. A curious point, which is very noticeable, is the general fine growth of most trees on the Lower Hills compared with that in the Terai. Thus the *Dillenia pentagyna*, in the Terai usually a short gouty-looking tree, on the hill sides throws up a stem often branchless from 40 to 50 feet from a massive buttressed base; the *Careya arborea*, in the Terai usually a small gnarled tree—on the hill sides has a tall cylindrical stem and gives a timber which from its dark red color, lightness and capability of being easily worked, ought to be much more used than it is at present; but of course, it is the custom of the country to use sal or toon, and very difficult it is to introduce a new timber. *Lagerströmia parviflora* is another tree, which, especially at Bamunpokri and Sookna, grows to an enormous size though rarely of a size fit to give timber in the Terai. This tree has a fine hard wood, but it is never used, though experiments will shortly be made to test its durability as Railway sleepers. East of Bamunpokri are the Sookna forests, extending away to the Mahanadi and full of valuable timber. Conspicuous among trees of value in these forests are the "Champ," *Magnolia sp.*, and *Michelia champaca*, giving a yellowish-grey easily-worked wood of great demand for planking and furniture; and the "Lampattia" *Duabanga Sonneratoides*, a huge tree easily recognized by its drooping branches bearing large closely set opposite leaves, and terminating in a cluster of big fleshy white flowers succeeded by a dark-coloured capsule. This tree is a recent admission to the list of useful timbers; it is now extensively used for tea boxes; is found to be exceedingly good for 'dugouts'

as it is not liable to warp, and on the Nepal frontier is much used for cattle troughs. Its wood is rather light, open grained, of a yellowish colour, has a satiny lustre, and is smooth to the touch. There is also the "Goguldhup" *Canarium sp.* also extensively used for tea boxes, though its wood is not so good; it is white, rather resembling that of the cotton tree, and is very easily rotted. Near Sookna is a fine forest of sal and chillauni with bamboos on the slopes, and towards the Mahanadi there is a great deal of 'saj,' and a few 'toon,' which have escaped the eyes of the searchers for tea box timber. East of the Mahanadi the vegetation is much damper, the Indian-rubber tree makes its appearance, and the valleys are filled with the strange forms of screw-pines, and 'palms.' Among the latter the most conspicuous after the canes are the curious *Wallichia disticha*, T. Anders., with its leaves arranged in opposite rows in the same plane like those of the *Urania speciosa* of Madagascar; the tall cylindrical stem and fern-like leaves of the *Caryota urens*, the elegant *Areca gracilis*, and most lovely of all, the *Phœnix rupicola*, T. Anders., which, in the precipices of the Goramara and Sivoke Hills, throws out its long slender stem crowned with soft delicate leaves, and yellow flattened seed stalks from crevices where it could hardly be expected to find sufficient soil for its roots. Both the *Wallichia* and *Caryota* are eagerly sought for by the Lepchas, who make a kind of sago from the interior of the stems, and consequently they are both rather in danger of extermination as population increases, unless there is a very strict prohibition against their being cut.

It is difficult to describe the localities where the India-rubber tree flourishes best, as it seems to be found both on the dry sunny ridges with a southern aspect and in the deep steamy valleys, but there is little doubt but that it is much finer and its supply of rubber more complete in the inner valleys running parallel to the base of the hills. The system of the collection of the India-rubber is too well known to need special description, but nearly all the trees of the Darjeeling hills have been much overtapped, and will require some years' rest before they will again give any abundance of sap. It is questionable whether

here at its extreme western locality it is worth cultivation, but it is found to be easily raised from seed, and experiments are now being made in planting it in baskets to fix in the forks of trees; in the course of a year or so the roots penetrate the interstices of the baskets and adhere to the tree while the basket decays. East of the Teesta the lower Hill forests are almost unexplored, though a certain amount of sal has been brought from the Leesh and Gheesh rivers. In the Chel valley round Dalingkot are fine forests of toon, saj, and chilauni, with other gigantic trees, while between the Chel and the Jaldoka the chilauni is the prevailing tree and India-rubber is very scarce, if not entirely absent. The forests of the valleys resemble much those of the lower hills, except that toon is rather more common, and the general vegetation of the Upper Teesta is of a much dryer character than the near the exit of that river at Sivoke. In the Teesta valley and in those of the Chel and Neera canes are very common, in the latter two the *Calamus montanus*, T. Anders., prevails, while that cane, owing to the demand for it, is now almost unknown on the Teesta, and is generally replaced by the slender *C. Leptospadix*, Griff., the common *C. flagellum*, Griff., or the straight growing *C. Schizospathus*, Griff., which latter seems to penetrate the farthest west of all. Noticeable among the useful trees and shrubs of these Lower Hill forests are the Camphor-wood, '*Cinnamomum glanduliferum*, the "Taj," *Cinnamomum albiflorum*, large quantities of the bark of which are annually collected and exported as Cassia Cinnamon, and the "Hurdi," *Morinda sp. sp.* shrubs whose roots give a fine yellow dye much used by the Lepchas and Mechis in the bright-coloured cloths worn by them.

The term '*Middle Hill Forest*' has never yet been used to indicate the forests between the elevations of 3,000 and 6,000 feet. The term is not a good one, but it is difficult to find a better.

When the reserved forests of Darjeeling were gazetted in 1865-66, all Government forest lands above an altitude of 6,000 feet, and below that of 3,000 feet, was reserved, and the land between these altitudes was held fit to be given up to cultivation, especially for tea. In those days, it is presumed, the toon tree

was not held to be of much value, and it was probably not contemplated at that time that the demand for toon wood would be so great as it is at present. Now, the finest and largest specimens of toon timber occur just in the belt we are noticing, and when cultivators, first the Lepchas or Nepalese, who burnt the jungle to make fields of maize, murwa or mustard, cleared the land; the toon tree was indiscriminately felled along with other species, and now, in some places, huge logs of toon generally partly burnt are found lying in the middle of the old cultivations, most of which, if brought to depôt, would prove of great value. In the beginning of the year the writer was passing through some Lepcha cultivations in the valley of the Reyang, at an altitude of about 4,000 feet, when he noticed four large toon trees; of these two were still standing, though they had had all their branches lopped and were putting out everywhere small shoots. The other two were lying on the ground, and one of them had been converted into a huge rice-pounder for the use of the Lepchas of a neighouring house. The cubical contents of these four were :—

No. 1 ...	211 c.ft.	standing	actual measurements.	
„ 2 ...	375 „			
„ 3 ...	720 „	fallen		
„ 4 ...	400 „	„	(approx. measurements.)	

Total ... 1,706 c.ft. Allowing for wastage, and supposing 1,500 cubic feet fit for cutting up, we should have, of ¾ inch tea-box scantling 1 foot broad, the enormous amount of 24,000 running feet. This will give some idea of the size of toon timber in the old forests.

The log No. 3 had	mean girth ...	12 feet.
	length ...	80 „
The mean girth of No. 2 was	...	20 „

Similar logs were also seen, subsequently, in Lepcha cultivations on the upper waters of the Balasun, and trees of this size and in fine growth are by no means rare in the forests east of the Teesta, especially round the head of the Rilli valley. The great drawback to the reservation of these forests, however, is that the toon tree is never found to grow gregari-

ously—one here and one there—at the most one per acre, so that the forest could scarcely be reserved on the strength of the toon alone. But there are other trees of great value in these forests, among which we may mention the 'Mahua,' *Engelhardtia spicata*, whose timber, recently introduced, is now a good deal in demand. It is a pretty wood of a light reddish gray colour, has fine medullary rays, and a satiny lustre; the Indian chestnut, *Castanopsis Indica*, the best of the numerous chestnuts of Darjeeling for making shingles; the Cherry, *Cerasus puddum*, a sweet scented wood which works easily and makes beautiful furniture; the "Ootis" or Himalayan alder, *Alnus Nepalensis*, an enormous tree which also reaches up to 7,000 feet, and has a wood resembling that of the English alder, the "Pipli," *Bucklandia populifolia*, which too also reaches up to 7,000 feet, with a fine hard reddish wood, somewhat resembling sal, and lately come into extensive use for planking for which it is found to suit admirably; and last, but by no means least, the walnut, *Juglans regia*, whose favorite habitat appears to be the lower slopes of valley at about 5,000 feet altitude, and of whose timber the door and window-frames of most of the older Darjeeling houses have been constructed. The European character of this middle hill forest is sometimes very remarkable; in one small forest near Kalimpoong the following European trees were found, though of course the species were different:—Oak, chestnut, cherry, maple, birch, alder, all of them fine large trees. The middle hill forest is always much mixed, and in the working plans, we shall have to endeavor to help, as much as possible, the growth of walnut, toon, chestnut, cherry, and pipli, and to make these species replace, as far as possible, the commoner kinds.

This forest reproduces admirably as coppice, instances of which are well seen about 'Nagri,' to the west of the Balasun and around Kalimpoong. At Nagri the chief and almost only species are chestnuts and *mahua*, and it certainly seems that the best system of working these forests at an altitude at which the chief demand is for firewood and charcoal for the tea-plantations with only a limited supply of other timber, except toon, would be that of 'coppice under standard'. To grow toon

properly it will probably be necessary to make plantations, but for ordinary purposes 'coppice under standard' would seem the most profitable. The great difficulty will of course be to transform the present high forest into coppice without allowing it to get into the state of scrub which is so characteristic of the western hill-slopes at 5,000 to 6,000 feet. These slopes, the results of abandoned cultivations, are generally covered with a thick growth of worm-wood with the yellow raspberry and shrubs of the following species: *Mæsa Indica*, *Sauranja*, *Eurja*, &c., &c., and a small straight growing tree having much the appearance of the aspen poplar *Macaranga Indica*.

The middle hill forest is at present very scarce west of the Teesta. A few patches on the Tharbo spur and a small forest at Nagri are all that are to be found west of the Balasun River; there are also a few patches on the Nahor, Hopetown, and Dootherea spurs and around Kurseong, but the chief forests are those round the head waters of the Mahanadi River. East of the Teesta they are not common still, till the main ridge is passed, beyond which almost the whole country is forest, and this description consequently finds its place with the others.

A noticeable feature in many of these forests is the prevalence of tree ferns, *Alsophila*, with tall graceful stems and feather foliage, making them at once the most conspicuous and the most beautiful of forest plants; the dense thickets of hill cane *Plectocomia Himalayana*, especially found wherever the rocks are too steep for big trees, and the multitude of large-leaved *Aralias* whose leaves are often much used for feeding cattle.

THE TEMPERATE FORESTS.

Oak forests.—The belt between 6,000 and 8,000 feet altitude is almost entirely covered with forest consisting of trees of enormous size and majestic appearance. The line of about 6,000 feet altitude is almost everywhere well-marked as being the upper limit of usual cultivation, and because the forests above that line were, almost all, originally reserved for Government purposes, so that when clearances were made they were made below, not above, the approximate 6,000 feet line.

The Oak forests cover the ridges which run from Senchal in different directions, *viz.*, Mahalderam, Tukdah and Goompahar.

with the spurs of Simonbong and Rimbick towards the Rumaun River, west of the Teesta; while east of that river they cover the spurs which radiate from Rechee La towards Thosum La, Pankasarry, and Samthar.

They consist principally of oaks, *Quercus lamellosa, annulata* and sp. sp.; chestnuts, *Castanopsis rufescens; Magnolia Campbellii; Michelia excelsa, lanuginosa and Cathcartii* (the latter two often extending right down to 5,000 feet) laurels, maples and other trees.

Of these by far the commonest is the "*Booke*" *Quercus lamellosa*, a huge spreading tree with large leaves and ringed acorns measuring often 2 inches in diameter. The wood is like that of English oak, but has the medullary rays exceedingly developed. It is very pretty when well worked and polished, but is rather liable to warp, consequently it is chiefly used for big beams for the construction of houses and bridges; it is very greatly in demand in Darjeeling. The most magnificent and probably the most useful trees are the *Champ* or *Magnolias*. The *M. Campbellii* is a fine tree found only between 7,000 and 8,000 feet, and especially on the summit of Senchal. In April when leafless, but covered with its brilliant pink flowers, 8 or 9 inches in diameter, it is a sight alone worth a visit to Darjeeling to have seen, and as at that season also the white magnolia *Michelia excelsa*, also leafless, puts out its masses of snow-white fragrant flowers, these two flowering trees, contrasting with the delicate light green of the young leaves of the maple, and the sombre foliage of the evergreen laurels, make up a forest scene of wonderful beauty. Indeed, at all times, these oak forests have an unceasing charm, whether we see them in the spring with the sunlight piercing through the leaves to light up the different colors of the foliage, or in the rainy season, when in the forest paths, we pass one by one, the giant trunks clothed with masses of brilliant hanging moss, and lowering through the dripping misty atmosphere. But, perhaps, it is in October and November that these forests have their finest appearance, when the leaves turn to shades of every conceivable hue of yellow and red, and the folliage of the trees is dotted with the scarlet seeds of

the magnolia or the bright brown prickly fruits of the hill chestnuts.

In that season, too, the ground vegetation is at its loveliest. Brilliant-flowered balsams and painted-leaved *begonias* peep from every mossy cranny of the dripping rocks; above masses of *Strobilanthes* spread a blue and purple hue over the scene; ferns of every form and species and delicate *Selaginellas* cover every bank, while above the branches are festooned with gorgeously flowered climbers, *Thunbergia*, *Craufurdia*, or *Dicyntra*.

But to return to the magnolias they have a rather light yellowish-colored wood, with a strong and rather unpleasant smell, which is very extensively used for flooring and for furniture. The wood of the chestnut is white, hard and strong; not so liable to shrink and better in damp places than the oak; it is esteemed the best for door-frames, and is very much used for shingles.

There are very few other woods which are ever used, but we may mention three species of laurel, the "Lali," *Phœbe lanceolata*, the "Kaula," *Machilus odoratissimus*, and the "Lepchaphul," *Actinodaphne sp.*, all of which are used for planking, and more especially in native houses; the maple, *Acer Campbelliæ* and the Hill Chilauni, the *Echinocarpus dasycarpus*, with a hard good wood, which is rapidly coming into use. The tree itself is one of the most beautiful in the forest; it rarely grows to a great height of stem, but sends out many branches at about 20 feet from the ground, and the leaves droop round the tree in a most picturesque way. Considering the demand of the stations at Darjeeling and Kurseong, and those of the Public Works, and of the numerous surrounding plantations, these forest will best be worked as high forest; there can be very little doubt but that the system of natural reproduction; of course aided in spots, by artificial dotting in of good species, will succeed admirably. At present from the Foresters' point of view the aspect of the forests round Darjeeling is not very good—as of the standing trees of any size fully $\frac{5}{8}$ths are long past maturity, while another $\frac{3}{8}$ths are younger trees of almost useless timber. The term of maturity of oak, magnolia, and chestnut is probably 120 to 150 years, but the term should

not be too long, and 100 to 120 years will be quite sufficient. When the annual cuttings are made all over mature trees should be cut, as they are often quite worthless, except as fuel, as well as a large number of the useless kinds—leaving merely sufficient to give a very light cover. The oaks, chestnuts, and magnolias all ripen their seeds about the same time, November, and germination generally takes place in the following May, so that the young plants should be up and beginning to establish themselves well before the heavy rains set in. In October, consequently, the moss and small shrubs should be cleared from the cutting, as it seems that the seeds do not germinate until they reach the soil below the mossy covering. In fact, the treatment of these forests should resemble that of the mountain forests in Europe, to which the working plan of a conversion for the "Garden" system to that of natural reproduction has been applied. At present the system of sale of standing trees, one by one, in which naturally only mature trees are cut and over-mature ones left is fast spoiling the forests, though with a small establishment and untrained foresters it was almost impossible to apply a better system. On the higher slopes in these forests the commonest vegetation is that of the small hill bamboo "Maling," which grows very gregariously in exceedingly dense thickets, entirely preventing the growth of other vegetation. On Simonbong below Tongloo at 8,000 to 9,000 feet, it forms a dense compact forest; the stems barely 6 inches apart and growing to a height of 20 to 30 feet. The darkness of this bamboo forest is most curious, and it is only here and there that a solitary birch, yew or magnolia penetrates through the bamboos—probably the last survivors of the old forest before the bamboos usurped its place, and by their dense growth killed off all younger trees. This little "Maling" bamboo is very valuable, as not only is it almost exclusively given as food for ponies in Darjeeling, but its stems split up are made into the mats with which all native houses in the hills are roofed. The chief place where these are made is at Sookia Pokri in the Goompahar forest, and the permit for the right of collecting and working up these bamboos produces a keen competition at the yearly auction.

Among other produce of these forests we may mention the little creeper, *Rubia cordifolia*, the "Manjit" or madder, large quantities of which are yearly exported for dyeing purposes, and the "Chiretta," *Ophelia sp. sp.*, for it seems to be the produce of many and not only one species, which is also greatly exported as a febrifuge.

The Rhododendron Forests, in which the trees are gregarious, are only found on the high points above 8,000 feet, although two tree species, the *R. arboreum* and *R. argenteum*, as well as the beautiful epipytic *R. Dalhousiæ* and *R. Edgeworthii*, and the small shrubby pink-flowered *R. vaccinioides* are found as low as 7,000 feet, and occasionally even lower. The chief species are, *R. Campbellæ* the commonest in the summit of Tongloo, with twisted pink-barked stems and crimson flower; *R. Falconeri* also common on Tongloo, and easily recognized by its large leaves covered beneath with a dense rusty tomentum, and its cream-coloured flowers; and *R. barbatum*, a smaller kind with bright crimson petals. The flowering season is the end of March and April, and at that time the colour of the forest around Tongloo is most magnificent. The wood of the Rhododendrons is pinkish and close-grained, but is not in general use. It is very good as firewood. Associated with the Rhododendrons we often find the *Andromeda ovalifolia*, the red flowered *Buddleia Colvilli*, and *Hydrangea altissima*, but the commonest trees are the birch, maple and whitebeam, and the yew is occasionably found of immense size, and growing much straighter and taller than it usually does in Europe. Of two trees measured by the writer one had 20 feet girth, but was broken at the top, the other 16 feet with a straight cylindrical stem of 30 feet high.

The Fir Forests have, as yet, scarcely been examined; the principal species is the silver fir, *Abies webbiana*, and with it is often found a juniper, *Juniperus recurva*, and the *Abies dumosa*. They are not worked as they are so inaccessible, although the fir timber is good, and as they are not the property of Government; but, with the Rhododendron forest form part of the large tract of land given to the Cheeboo Lama in recognition of the services rendered by him to Government.

The Government Reserved Forests in the district occupy 105 square miles, or 9 per cent. of the total area, giving 0·7 acres per head of population: this is only including the forests west of the Teesta*; those east of the Teesta will probably give an area of about 120 square miles more; the reserves include most of the sal and sissoo forests of the Terai (with the exception of the greater part of the western sal), the lower hills facing the plains, almost the whole country between the Mahanadi and Teesta, the Teesta and Rungeet valley forests, and the oak forests of the Senchal, Tukdah and Goompahar ridges. There are, properly, two or even three sub-divisions, and the number of ranges is six, *viz*:—

No. 1.—Sivoke and Lower Teesta Forests.
" 2.—Sookna and Mahanadi Forests.
" 3.—Forests west of the Balasun.
" 4.—Bamunpokri Forests and Plantation.
" 5.—Temperate Forests.
" 6.—Upper Teesta and Rungeet Forests.

These are under Foresters, with pay varying from Rs. 20 to 40 per month, and they are assisted by 17 watchers and 5 peons.

1. The timber depôts are:—*Julpigoree*, to which Sivok is merely a feeder depôt. This is the most important, as it receives all the timber from the Teesta and its many tributary rivers, and as the river is always floatable;
2. *Silligori* on the Mahanadi, now not much used, and will be replaced by
3. *Sookna*, the most central point of the Terai, and especially useful as a sleeper depôt;
4. *Rakti* on the old road to Pankabary, and
5. *Nuksurbary* receive the timber from the western forests.

The chief timbers in use are:—

1. *Sal.*—Exported by purchasers or used by Govt. departs.
2. *Sissoo.*—Ditto ditto ditto.
3. *Toon.*—Local consumption only; tea-boxes and general furniture.
4. Hill timbers for building. { Booke (*Oak.*) / Champ (*Magnolia, &c.*)

4. Hill timbers for building.	Katoos (*Chestnut.*) Pipli (*Bucklandia.*) Akrot (*Walnut.*) Lali (*Phœbe*) Kaula (*Machilus.*) Lepchaphul (*Actinodaphne.*) Chilauni (*Echinocarpus*).
5. Plains Timbers, for building.	Chilauni (*Schima*). Saj (*Terminalia*). Champ (*Michelia*).
6. For Tea boxes.	Toon (*Cedrela*). Mahua (*Engelhardtia*). Lamputtia (*Duabanga*). Goguldhup, (*Canarium*). Kabashi, (*Maple*).
7. Other useful trees but rarely used.	Khair (*Acacia catechu*). Sitsal, (*Dalbergia latifolia*) Sida (*Lagerströmia parviflora*). Malligiri (*Cinnamomum glanduliferum*). Cham (*Artocarpus Chaplasha*).

The Darjeeling Division Proper has only been constituted in the last year; formerly it formed a sub-division of the Cooch Behar Forest Division, which included the Julpigori and Goalpara districts; the revenue has lately increased considerably. The Revenue of the whole Cooch Behar division was in

	Rs.
1871-72	40,000
1872-73	55,000
1873-74	52,000

while in 1874-75 the revenue of the Darjeeling division alone was Rs. 51,000, or, including outstandings Rs. 58,000.

Considering the rapid extension of tea cultivation, there can be no doubt that the revenue is as yet in its infancy, and that the Darjeeling forests will hereafter be amongst the most valuable in the Indian Empire.

On Grazing.

By J. McKee.

Of many forest questions on which discussion would tend to throw light none appears of greater importance or more complicated in its general features than that of grazing. Treated in connection with its results on young forest growth, or with regard to the large population interested in obtaining good pasturage for their cattle, this subject ranks with the foremost of those relating to forest management, requiring special consideration from both departmental and civil officers. The former are sometimes backward in reflecting that grazing is indispensable to the gaôli and his herds, or do not fully consider how dependant they are on the forests for their requirements in this particular; the latter are apt to discredit the fact that cattle do much injury, or do not appreciate the real extent of damage caused by admitting them into a forest; both sides perhaps have ideas on the subject that will bear correction or may be useful if ventilated through the medium of the "Forester."

The question seems to divide itself into three major heads:—

First.—Grazing looked on from a forest point of view.

Second.—As considered in connection with the peoples' requirements.

Third.—Difficulties in reconciling the two interests.

That damage is caused by allowing cattle to graze in forests which are being restored, is to some extent recognised by the majority of persons acquainted even slightly with forest conservation; but it does not appear to be generally understood how hopeless a fact natural reproduction becomes when this privilege is allowed, nor what vast injury to young growth is rendered certain by the presence of comparatively only a few head of cattle in a forest under improvement by natural means. It is not sufficient to simply prohibit felling or the carting away of usufruct from a tract, which it is desired to bring to a more wooded condition; in addition to such negative advantages something must be done to increase the existing crop by fostering natural reproduction, or by artificial means, such as planting and sowing. Whenever

the former is sufficiently promising to bring about the desired improvement, it is obviously the better of the two methods, owing to its cheapness and to the greater likelihood of the plants so raised succeeding better than those which, having been reared in nurseries, have to run the gauntlet of an after transplanting. But experience has proved that a timber crop cannot be materially increased so long as large herds of cattle, goats, and sheep are allowed to graze at will over the forest; all, or nearly all, the natural seedlings are trampled or browsed down by the animals in their search for food, and much of the sapling growth is injured by the cattle rubbing up against it, or by the cowherds lopping its young branches for fodder, in those places where the grass has dried up or been thoroughly grazed down. Such damage is not so perceptible as a total destruction of seedlings, but must nevertheless be great, as it doubtless causes in most cases an irregular growth, much the same as bad pruning would, and frequently the destruction of the trees for useful purposes, and thus detracts bot[illegible]om their future economic and pecuniary values. Graz[illegible] is never allowed in European forests until the new growth, either coppice or seedling, is sufficiently advanced to be beyond injury by cattle, and then only under certain stringent conditions. The herds must subsist on the meadow lands or root crops. Here, in the plains of India, we have little meadow land properly so called, and no root crop to fall back on; but in most provinces there are large areas of private forest and Government waste land available for grazing, which bear so large a proportion to the tracts taken up for special treatment and called reserves, that it is hard to understand how any substantial grievances can arise by completely excluding cattle from the latter.

Experiments have been carried out in the Central Provinces, which seem to prove that in some forests the fact of admitting cattle even in the small number of 1 head to 15 acres will, in four months, completely destroy all seedling growths. The following is the account given :—

Two blocks of forests from which cattle had been excluded for four months—from 1st April to 31st July—were inspected

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about the latter date, when large numbers of seedlings of the better classes of timber trees were found in all directions and situations, although the rainfall up to that period had been much below the average. On the 1st August licenses were issued allowing 256 cattle to graze in one of these blocks, containing about 3,840 acres, some few plots of ground in which seedlings were present having first been hedged off to protect them from injury. The block was again inspected towards the end of November, when it was observed that the yearling plants had completely disappeared, except in those places which had been enclosed.

It may be interesting to give here an instance of the damage caused by cattle as described by Darwin in his "Origin of Species," page 83.

"But how important an element enclosure is, I plainly saw "near Farnham, in Surrey. Here there are extensive heaths, "with a few clumps of old Scotch firs on the distant hill-tops. "Within the last ten years large spaces have been enclosed, and "self-sown firs are now springing up in multitudes, so close "together that all cannot live. When I ascertained that "these young trees had not been sown or planted, I was "so much surprised at their numbers that I went to several "points of view, whence I could examine hundreds of "acres of the unenclosed heath, and literally I could not "see a single Scotch fir, except the old planted clumps. But "on looking closely between the stems of the heath, I "found a multitude of seedlings and little trees which had "been perpetually browsed down by the cattle. In one square "yard, at a point some hundred yards distant from one of the "old clumps, I counted thirty-two little trees; and one of them, "with twenty-six rings of growth, had during many years tried "to raise its head above the stems of the heath, and had failed. "No wonder that, as soon as the land was enclosed, it became "thickly clothed with vigorously growing young firs. Yet the "heath was so extremely barren and so extensive that no one "would ever have imagined that cattle would have so closely and "effectually searched it for food. Here we see that cattle absolutely determine the existence of the Scotch fir." Again the

following extract from a paper on the Island of Cyprus, published in the "Revue des Eaux et Forets" for February 1874, is intimately connected with the same subject. "It is not the axe so "much that I accuse of having destroyed the forests of "Cyprus, as the goat. It is for this animal that the shepherd "kindles the great conflagrations, which pick out above all "for destruction those forests which are highest and thickest "and contain the most fertile soil, which he wishes to convert "into grazing land. The goat browses down young reproduction, "and leaves in its place endless thickets of cistus, arbubus "and broom or rocky exposed ground."

That fire is a chief obstacle to reproduction is now scarcely disputed; the result of protecting a forest from its ravages for a few years clearly prove it, but it is popularly supposed, and with good reason, that fires are in most cases caused by cowherds for the new crop of grass, which springs up much more luxuriantly in a forest constantly burnt, than in one which has been protected for a year or two; and, if this opinion is correct, it seems hopeless to effectually exclude the fires without first expelling the graziers; get rid of the cause and its effect will also disappear, or at least will have a better chance of so doing.

On the other hand, when considered from the agriculturists and grazier's point of view, there can be no doubt that stringent forest protective measures interfere with their convenience, past habits and customs, and in many cases cause considerable loss.

In the provinces to which the writer is attached much of the best grazing land is situated in those tracts immediately under departmental superintendence, and each year about the end of February, when the forests belonging to the villages and those called unreserved, are becoming burnt up with heat or browsed down so close that good pasture can no longer be obtained in them, large herds are sent up to the wilder and more hilly lands, of which the forest reserves form the cream, there to remain until the commencement of the rains, when vegetation around the villages in the plain bursts forth again into new life and admits of their being driven back to the home pastures. These far away grazing tracts are looked upon as all important by the owner of cattle; he considers them a great reserve to fall back on in the

hot weather, and is willing to pay a year's duty for the privilege of grazing over them for the three and a half months preceding the rains, although it is more than probable he has already paid 12 months' dues to the civil or forest officer of his district for permission to graze in the Government forests adjacent to his village; from which it would appear that, although the unreserved and private forests bears so large a proportion to the reserved areas, they are not in the eyes of the people qualified in all essentials to meet their requirements. But besides the above class of men, who would, as a rule, live at a distance from the forests here alluded to, there is another body with a much stronger claim on the consideration of the department, *viz.*, those whose villages actually adjoin the protected area, and who are nearly or quite dependant on it for good grazing. If these men are sternly shut out from the reserve, they must make the best they can of the village pastures, generally poor enough, sometimes altogether wanting, or they must strike their tents and move elsewhere,—an exodus not even meditated by such men without much heart-burning and the greatest reluctance; especially when, as is frequently the case, they own or cultivate a considerable portion of the land belonging to the village in which they live. Again, there are always a large number of cattle in every village, generally the property of the ryots, kept up for field work, which must be present on the spot during the greater part of the year, and for the well-being of such it is absolutely necessary that grazing be obtained within a reasonable distance. But when the only fodder ground within miles happens to be strictly protected against cattle, what is likely to be the result? Clearly the cattle must suffer, in some cases lapse into bad condition and die from want of proper sustenance; complaints of a bitter nature will be made, much ill-feeling towards the department in the abstract and the forest officer in particular as its visible representative be exhibited, and the work of protecting the forest from fire and cattle be made infinitely difficult by the peoples' opposition and obstructiveness; the latter being shewn in a sullen reluctance to give any assistance by labour in extinguishing fires when they break out, the

former by grazing their animals during the night time when the forest chuprasies are off work, and by actually setting fire to the grass in the reserve during the hot weather, which may be done without much fear of detection, for of all forest offences, none is so easily committed and so difficult to trace and punish.

The important question then arises: What are the practicable means of obtaining the two following results? *viz.*: protection to reproduction from cattle, and grazing for the people dependant on the reserves. Three methods suggest themselves, by all of which the above ends may be partially gained, each however containing some difficulty or weak point which will require careful consideration before adoption, and will depend somewhat on the character or shape of the forest to be treated.

First.—When the forest is a long narrow tract.

Secondly.—When the area is more compact and is nearly as broad as long.

In the first case, grazing belts or broad sections half a mile wide might be demarcated at intervals through the breadth of the reserve. This system has, we believe, been introduced into the French forests with success. Its advantage is, that grazing would be placed within fairly easy reach of the adjoining inhabitants, its disadvantages, that the reserve would thereby be split up into numerous compartments, the protection and conservation of which would be more expensive than if it was treated as a whole, as it would necessarily entail more demarcation and a stronger body of forest guards to protect the extended boundaries; besides which it would be always difficult to restrain the graziers and their cattle to the belts put aside for them and prevent them from wandering into the protected area. Still this system might perhaps be worked with success in forests, where the proposed belts could be demarcated or marked out by strongly defined natural boundaries, such as ranges of hills and streams. For the other form of forest, *viz.*, a compact squarish or circular block, a belt of grazing land might be lined off half a mile or upwards in breadth parallel to its outer boundary, in which cattle might be admitted until

the inner forest was improved beyond damage, when an exchange of land could be granted, cattle being allowed into the forest that had undergone improvement, while the outer belt was being restored. This method would have the advantage of placing pasture land immediately within reach of all the villages adjoining the reserve, but the difficulties alluded to above, *viz.*, of cost, and of keeping the animals strictly within prescribed limits again present themselves. Two boundary lines would have to be demarcated or in some way distinctly defined, and there would be two lines to protect, one against ordinary trespassers, and the other against grazers. It is probable, however, that in many cases the privilege of obtaining grazing would be so thoroughly appreciated that the people on their own behalf would define the inner line, each village undertaking to demarcate the parallel belt adjacent to itself. There is however another objection to this method that should be stated, *viz.*, that it often happens, at least in the writer's province, that the best portions of forest land are situated nearest the outer boundary, and that they would be thus turned into grazing lands for a long term of years, after which they would be more difficult to bring to a reproductive condition, than at present.

The third arrangement may be applied to either of the foregoing characters of forest. It consists of demarcating and putting aside two or three large blocks in which cattle might be allowed grazing, while they are excluded from all the rest of the protected reserve. This system recommends itself as being by far the most simple and least expensive of the three ways of meeting the difficulty. If these blocks are chosen in the proximity of those villages which own the largest herds and have relatively little grazing land of their own, the necessities of greatest importance are satisfied, the objection against the first and second method, *viz.*, of expense, is avoided or much lessened, for experience has proved that the people will in some cases, undertake the demarcation and protection by burning a line round the blocks set apart for them, and there is no occasion to condemn the best land all round, the forest to the damaging effects of large numbers of trampling hungry bullocks and

buffaloes for a long term of years. The one objection against this method is, that certain villages would sustain some inconvenience in being situated at a distance from the open block, but this grievance would be reduced probably to those in which cattle were not numerous, and which therefore might obtain sufficient grazing in the private forests belonging to their own or neighbouring villages. It has been lately carried out in some forests of the Central Provinces, wherever large cattle owners live on the borders of the protected areas, and where these last happen to be the only grazing lands within reach, and has up to the present worked successfully.

Journal of a tour into the Karenee country, east of Tounghoo.

By M. H. Ferrars,

Assistant Conservator of Forests in British Burmah.

March 5th.—Tounghoo to *Pyon-choung*, 6 miles.

March 6th.—Pyon-choung to *Paylawa*, on the Thoukyagat river, 15 miles. The road lay through the Government teak plantation; the forest as far as the first ascents is characterized by plentiful production of bad teak. On somewhat higher ground this forest was succeeded by arid forest, consisting almost entirely of creepers. Succeeding this was inferior Eng (*Dipterocarpus tuberculatus*) forest. Above the Eng forest was a a region of unequal evergreen forest, in the better parts of which a *Thitkah* (*Pentace Burmanica*) tree was occasionally met. Finally above the evergreen forest the ground was covered simply with low bamboo jungle.

March 7th.—Paylawa to Bangalay, 8½ miles. The road lay through scrub of a few years' growth on old *toungyahs*; (coomrie clearings) stunted teak trees were frequently met. On the higher points elephant grass and bamboos were the principal vegetation. Towards *Bangalay* signs of the stunted forest of high elevations were perceivable; the two *cinchona* trees at Bangalay appeared to be prospering, the larger of the two is seeding; both are spreading moderately in the crown and clearing themselves of the lower branches. Elevation of Bangalay 3,150 feet.

March 8th.—*Baugalay* to *Kyay-choung*, 7½ miles. The whole country within sight occupied by *toungyah* (coomrie) cultivation, the *yahs* (clearings) of enormous extent, and in most cases but recently cleared. Teak trees lopped and mutilated. The forest that has yielded to this toungyah system probably the evergreen, to judge by the patches left standing.

March 9th.—*Kyay-choung* to *Moo-choung*, 4 miles. Elevation not great. Toungyah scrub alternating with poor teak forest.

March 10th.—*Moo-choung* to *Moh-gyoh-pyit-choung*, 1½ miles. Nothing but *toungyahs* far and wide. Patches of evergreen forest in gorges, but imperfect poor forest where spared on the face of the hill side. Wild plantains common. Betel gardens commencing. Both the *cycas* and tree fern frequent.

March 11th.—*Moh-gyoh-pyit-choung* to *Kwat-tyay*, 4½ miles. Ascent of the watershed; traces of evergreen forest, but neither high nor dense, and interspersed with bamboo. Toungyahs reach as far up as the belt of stunted forest, (forest consisting principally of low branching trees covered with moss) which occurs here at 3,500 feet. Stunted Thitsee (*Melanorrheva usitatissima*) formed the link between the two above forests. The watershed takes a great turn east and west from its main direction. A remarkable difference in the vegetation is observable on the northern and southern aspects. The southern is covered with stunted forest of a very open and sparse character, and a sort of long meadow grass forms the immediate covering of the ground. The northern declivity is clothed with the densest evergreen forest, but abounding in creepers, and destitute of high or large timber trees. A little below the highest point of the watershed, 4,700 feet, *toungyas* were again met, but they were not extensive; the wild tea plant was one of the chief components of the scrub growing on the abandoned yahs. Here the first pine tree, long three-leaved variety (*Pinus Khasyana*) were met, in the shape of a few isolated struggling specimens of different ages.

March 12th.—*Kwat-tyay* to *Koo-saloh*, 8 miles. North-eastern declivity of *Oo-loh Toung* dense evergreen shrub forest with sparse crooked trees. Striking to the east for Karennee proceed along a great offshoot of the main range, the landscape

presents a perfectly novel appearance, namely that of *toungyah* cultivation in more or less hardy pine forest. The road passed through a forest, transitional to that beyond, in which the occurrence of the pine became more and more frequent. The pines appeared to be spreading on the fresh yahs, and were there the most striking element of the fresh relay of vegetation; they were also the principal element of the older blocks, although still rather sparse, and filled in between with scrub. The same stadia in the development of the pine forest, which we find in Europe were noticeable here; the birch scrub, with large brake ferns and long grass, which so often crops up on eminences and slopes that have deteriorated from leaf-tree to pine forest, has its perfect anti-type here. Similarly miserable struggling forest was found where the trees stood far apart and the ground was unprotected. In these places the ravages of insects were considerable, the stems frequently being deformed by a *tortrix*, which here seems to attack the middle or principal shoot in decided preference to the side shoots, probably owing to its singularly large development. Before reaching the pure pine region, although at equal or even greater elevations, openings covered with elephant grass still continued to occur, and large patches of leaf forest were met with. Even evergreen forest of the finest type, with occasional *Thingan (Hopea odorata)* trees, was found in the transitional pine forest. Ascending a steep eminence—4,500 ft., the decided pine forest was reached. The spring shoots were just developing; they had their spikes about ¾ inch long. The pine of this region has spikes 3—4—6 inches long, three in one sheath; the cone has a broad base and rapidly tapers; is about 1 inch in diameter at the base, and 1½ to 2 inches long; the *apophyses* thorny and hooked back.

On the crest of the hill the forest might be called intact, *i.e.*, the trees had reached their maturity. This was generally, but not always, the case on the tops of the high hills, and in a modified degree the forest was spared on the minor ridges and large spurs. The faces of the great slopes, including all the minor spurs, were under the toungyah system. In the mature forest the trees stood tolerably close, and had gained a considerable height for the exposed situation they occupied;

the largest trees in the block girthed 6 to 7 feet, the smallest 4 feet; the timber did not taper much. The growth was uniformly slow—about $\frac{1}{16}$th inch in the year. Turpentine and resin were oozing freely. The ground was covered with a thick layer of humus; this was found to be the case in quite young blocks, and proves with what success fire is excluded. The ground is quite slippery with the mass of dead leaves accumulated upon it. There is no undercover; a few branchy leaf trees fill up gaps, but do not appear ever to have vied with the pines in making height; brake ferns occur in little clusters, and an occasional cycadean is the only other characteristic of the vegetation. The white ants do not infest these forests; dead trees are slowly destroyed by other insects. The pine forest is always strongest on the ridge. It was never met with pure in deep ravines. During the whole of this march the aspect of the hill-side exerted an influence; the pine forest was much purer on the southern declivities, and was largely mixed with leaf trees on the northern; elephant grass was still occasionally found on exposed clearings. Reproduction was observed to take place very readily on deserted *yahs*, where a crest of seeding trees had been left standing on the ridge. Seedlings were found on all places where the thick layer of humus had been recently removed by fire, and where fires had not subsequently taken place. Once a few feet over the ground fire seemed to do very little injury to the young trees, the bark did not appear to suffer. Forest was seldom cut for *yahs* where the trees were over 4 feet in girth. The country makes quite the impression of a tract of European pine forest under management; the different age-classes and the rotation are so conspicuous. All land under *toungyah* cultivation, strictly speaking, presents the same features, but here the lines are more clearly marked and the age-classes more easily distinguishable owing to the character of the prevailing tree. The pine steadily advances from the lowest age-class to the highest; with each few years it shows a marked difference; it begins as young forest and goes on in an even block to become high forest without any uncertain stage; whereas in the *toungyahs* of the leaf-tree forests, the various ages of the scrub are less marked, and before

forest proceeds from it there is a long struggle between different trees and plants for predominance, and at the end of a full timber-generation the trees that held out do not form regular forest, but only a sort of foundation for one. The size of the clearings made in a year is here strikingly less than that of those made in the hills of British Burmah; may be that there are fewer cultivators, or that the land is more productive. At any rate the forest gets a fairer chance—a perfectly fair chance indeed—for there is a tolerable surplus of virgin forest, dotted throughout each valley, which is not to be found in the great toungyah districts of British Burmah. The less accessible hills in the Karennee pine forest seem to be altogether intact.

The different age-classes in the district appear to be equally distributed over the area, but every class is not found in one and the same neighbourhood; the distribution is such as to have a number of allied age-classes together, each class being frequently repeated. The rotation is two-fold. First, there is the set of blocks which are cleared every 15 to 20 years; these are large and are used for raising the main crops. Secondly, there is a set of smaller blocks or strips which are allowed to lie fallow two or three times as long as the former; very good forest forms on these, and the land, when cleared, is suitable for growing a series of vegetable crops, &c. The process of regeneration seems to be this. The bare *yah* on the slope is seeded for a couple of years by the trees left standing on the ridge; there being no combustible matter on the ground, the seedlings get a good start and are fire-proof afterwards; fires however are carefully and in general successfully excluded by the natives. *Kaing* grass (elephant grass) springs up simultaneously with the young pine, but before it has attained its full development—which it requires a few years to do—the young trees have out-topped it, and subsequently they drive it out of the field in their vicinity, paving the way for a quantity of undershrubs and young pine and leaf trees which then further oppress the grass. Under the struggling leaf tree scrub, the pine seedlings, which here seem to thrive in moderate shade, get ahead, and suppress the young leaf trees in their turn. In ten to twenty years the block is full. Under less favourable circumstances

the reproduction takes place in belts downwards from the ridge, the successive young generations of pine supplanting and suppressing the grass and scrub.

March 13th.—Koo-saloh to *Koo-moh-loh*, 3¾ miles. Pine forest as on the day previous; fine pine trees in the gorges among other trees at 3,400 feet. The landscape reminded forcibly of the parts of the Hartz mountains under spruce. Passed along some ridges, where the crest of seedling trees had been removed. The reproduction of the whole hill had suffered in consequence, and its eventual resumption by pine forest become delayed for an incalculable time. Bamboos and high elephant grass had occupied the vacant space. The denudation of the summit was not due to windfall. Windfalls were not observed anywhere. The growth of the timber improves greatly towards the end of this march. Borings shewed that timber was formed much more rapidly, ¼ inch in the year, the girth and height were greater. The largest tree measured was 8 feet 7 inches in girth and 100 feet in height. The cover formed by the high forest was much denser; there were in fact as many trees on the acre as could grow upon it. It would be difficult to point to any other forest tree in these parts for which acreage could be computed, with the exception of the Eng, and sometimes of Pyimma (*Lagerstroemia Reginæ*). The elevation of the luxuriant pine forest was 3,300, and the situation a moderate slope, resting on granite. The temperature of the same place at night was 47° F. A large *curculio* was found in dead wood, the larva bores 2 to 8 inches into the wood.

March 14th.—Koo-moh-loh to *Doh-loh-gyee*, 5 miles—Met with two species of oak; the one a large timber tree (*Quercus fenestrata*) but the timber coarse. The growth of the tree apparently fast. The other bore more resemblance to the English oaks, but was a stunted tree of no pretensions; the leaves were scolloped, the indentations rounded. The acorn was small and regular, but the cup composed of unthickened fine scales.

The pine forest continued as before. A tree was measured 10 feet 4 inches in girth; it appeared to be about 100 years old. In a part where cultivation had not been carried on for a long time, the sides of the hills were covered with stunted leaf tree

forest instead of pine, or the latter was largely mixed with leaf trees. It would seem that the working develops the pine forest, *i.e.*, makes the opportunity for the pines to monopolize the ground. But pure forest is not always a desideratum. The road descending abruptly and continuing to descend for a considerable length, the pine forest disappeared. It was succeeded first by patches of evergreen mixed with bamboos; and subsequently by bamboos with elephant grass. At the same time a change took place in the subsoil, *viz.*, from sandstone to limestone.

March 15*th.*—*Doh-loh-gyee* to *Thalan-loo*, 6 miles. Forest generally scrub with much elephant grass, some bamboos, and a few large leaf trees. Further on dense moist bamboo jungle. White ants re-appear. Bamboay (*Carega arborea*) and Thitseo become common again. Large areas are covered almost exclusively with Teh (*Diospyros kaki*) and an undergrowth of some cyperaceau. Pine forest is still observable on high hills at some distance, towards the east. The elevation markedly decreasing for a second time, the soil becomes arid. Proceeding a little further, some young teak of bad growth was found, and subsequently a considerable number of teak trees, but all of too bad growth to give serviceable timber. Elephant grass was—strange to say—the prevailing undergrowth in this inferior teak forest. Nearly every tree, out of which a sound plank could be got, had been girdled. In some instances the poll of the tree had been killed at a great height from the ground—40 feet or so, for the sake of a straight slender post.

March 16*th.*—*Thalan-loo* to *Gaw-tee-loh*, 7½ miles. The road led along the banks of several streams; *Thingan* trees of various ages and fine development were frequently met with; leaving the stream, teak localities were met with on the slopes, but of very indifferent quality. All serviceable timber was girdled irrespective of size. The girdling had taken place a great number of years since, and some trees that had been felled a long time were still lying in the forest. More and better teak forest was said to be on the adjacent hills. However the teak forest, such as it was, did not continue long, but changed for pure Eng with undergrowth of wild date. In

the Eng forest a second species of pine was found here and there; this pine had two needles in the sheath and the cone was 2 to 3 inches long and slender; in most cases curved. The scales were puckered in round the *apophyse*, so that the latter appeared sunk, instead of, as it generally does, protruding (*Pinus Massoniana*). The low hills in the vicinity were crested with this pine, which is found at a far lower elevation than the pine first described. The growth of the pine trees, which occurred in the Eng forest, was almost imperceptible. The largest pine met with here, was 9 feet 7 inches in girth. The lowest elevation in these forests was 1,000 feet. In a valley some fair teak and pyinkadoh forest was found; the teak trees were high, but nearly all crooked or forked. Any good trees had been girdled. From here the road led into a forest much like the dry forest of the Sittang plains, in which teak was sporadic. The ground rising and becoming very rocky no vegetation was noticeable except bamboos. A few good teak trees had stood scattered throughout, but had all been killed, and some felled. Descending again, the country became more fertile, in a nullah, close to two natural wells of great depth, a quantity of Thitkadoh (*Cedrela Toona*) was observed, and subsequently in following the course of the same stream, Thitkadoh became abundant on its banks. In toungyahs the teak trees were spared, but unmercifully lopped from top to bottom. Much bad growth may be ascribed to this cause. It becomes apparent that the country is a table-land, the average elevation of which will appear from the extremes subsequently noted. Young teak continues to appear from time to time, sometimes in full groups, but as yet it cannot be said that teak forest in any sense has been met. Eng forest develops again, but mixed with Hman (Gardenia) Teh, Bamboay and Khaboung, (*Strychnos nux vomica.*) Coming upon a deep descent the forest becomes worse instead of better, almost nothing beyond small bamboos and scraggy teak.

March 17th.—Gaw-tee-loh to *Too-choung*, 10 miles. Low hillocks on which the ground seems to be quite barren and burnt up by the sun, sparsely studded with wretched little trees. With this kind of land, Eng and bad teak-producing forest alternate.

Laterite soil appeared in the depressions, clothed with Eng forest, and on limestone eminences with a better kind of dry forest containing most of the members of that in which teak grows, but without the teak. This shews that there must be in the neighbourhood forest capable of producing good teak, but in what quantity it is not possible to surmise. Up to this point the road had led nearly due east; here it took a sharp turn north. So far, Koontie's (the Prince of Karennee) authority was not acknowledged.

March 18th.—Too-choung to *Nanpay-choung*, 10¼ miles; respective elevations 600 to 800 feet. A very inferior kind of teak forest without teak. Not even pyinkadoh (*Xylia dolabri formis*) grew in it. The best tree was Myoukchaw, and even that of poor development. Some hills were passed covered with bare jagged limestone boulders, recalling in miniature the appearance of Arabia Petraea; beyond this the landscape consisted of barren hills bordering a small, narrow, sloping plain covered with bamboo, where *yahs* had not recently been cleared. Kyun-na-lin (*Premna*) was a common tree in this little plain, and some good cutch trees (*Acacia catechu*) were found cut.

March 19th.—Nanpay stream for 5½ miles. Hillocks with bamboos and wretched scrub, almost barren. Landscape as far as the horizon the same. It was mentioned that the coffee-growing country in India bears the character of this place. Elevation 1,600 feet.

March 20th.—Nanpay-choung to *Kyet-poh-gyee*, 12½ miles. Proceed up a valley steadily rising. A total change in the productiveness of the soil. The bottom, and in most cases the sides, of the valley fertile arable land. Where timber was allowed to stand—in but few places and small scraps—Eng forest was luxuriant. Traces of teak were found, but no trees were allowed to attain any size. *Khaboung* and *Lepan* (*Bombax malabaricum*) crop up everywhere. The want of timber appeared to be greatly felt, for small scrub that had been cleared for cultivation was worked up into firewood at great distances from the villages. But this country was on the whole ill fitted for growing timber, for where patches of forest had been purposely spared for the sake of firewood—a surprisingly provident

measure, but inadequately pursued and needing extension—the trees often progressed badly. The cause was probably the want of shelter on the undulating plateau. If the attempt to cultivate timber for the immediate requirements of the villagers were made, and a number of age-classes in small consecutive strips established, the required shelter might be attained. The valley, by which the road entered, terminated in a high table-land consisting of gently undulating hills, mostly bare and all under cultivation. The face of the country was very like Wiltshire. Khaboung and Lepang were the principal trees dotted over the hills. On the eminences the limestone rocks were sometimes barred; large bamboos grew in these places, and were evidently held in great esteem, for each bush was fenced round, probably to protect the shoots, when they sprout out of the ground, from cattle. The *Thitkadoh* tree was very common on the tops of the hillocks, and particularly so in the villages, where it would seem to be planted and to grow very freely. It may here be observed that timber could be extracted from this country only by road; the drainage presents the feature of innumerable land-locked valleys which debar the possibility of floating. At an elevation of 3,300 feet some pines of the 3-needled variety were met. Where the hills are steeper, a slight tendency on the part of the trees to form forest is observable, there *bamboay*, *hman*, a species of oak and a few other trees are met together forming cover. High elephant-grass does not occur, nor does the fallow land become covered with jungle. A species of *Rubus* was noticed which bears a good fruit. In the neighbourhood of the chief village, Kyet-poh-gyee, elevation 3,600 feet, the land was energetically cultivated, the effect presented by the regularly bounded fields with the freshly turned up earth was quite European. From the same land, it is said, a succession of crops can be raised before it is necessary to let it lie fallow. Rye and wheat would probably give a better return on this soil than rice, and diminish the area which has to be put under cultivation at one time. The plough could be advantageously used. Terraces of small paddy fields are ingeniously contrived, so as to make the most of a deficient water supply. The soil here is, if not

richer, and, owing to the different configurations of the ground, more manageable, than that cultivated by the White Karens. The barbarous, irrational, wasteful way in which the latter go to work, contrasts nevertheless very unfavourably with the work of the Red Karens.

March 21st.—Remained at *Kyet-poh-gyee.* A great deal of rain. Extremes of temperature less than in the pine forest, 59° to 86° against 46° to 85.° A constant breeze, sometimes blowing very hard. Heard from a Mr. Manook, who professed to have a five years' agreement with Khon-htee for 1,000 logs of timber per year, that the practice of killing timber before felling was universal in Karennee. The timber is allowed to stand girdled for one year and upwards. It is usual for Khon-htee to work the timber as far as launching it into the Too river, and then to sell it in that condition. A man called Imâm professed to have advanced Khon-htee Rs. 14,000 for timber, which was to be supplied at the rate of Rs. 23-8 per log. The latter timber was to be obtained from the Toochoung forests below a certain point, at which an obstruction exists, and which prevents the extraction of timber from above. The forest above the obstruction in the river was said to be uncommonly rich; below it very poor. Being ordered to make an examination of this district I proceeded by myself for that purpose on the following day.

March 22nd.—*Kyet-poh-gyee* to *Nan-pay-choung,* 13 miles. (The same march as March 20th).

March 23rd.—*Nan-pay-choung* to *Taw-koo,* 15 miles. Quit the undulating country, cross a range of steep hills covered principally with elephant grass. On the other side there are traces of evergreen forest, and thin pine forest on the tops of the hills. All under *toungyah* cultivation. Some fine *Thingadoo* in the evergreen forest. Crossed a second range, of considerable height, from which *Kyet-poh-gyee* could be seen bearing 170° E. The eastern ascent of the range bleak and barren, it becomes more fertile on the west; and as the village of *Taw-koo* comes in sight, a fertile valley opens, where toungyah cultivation is carried on in small strips, as opposed to the enormous spaces laid waste at one time by the White Karens, the condition of soil and conformation being

quite similar. The forest displaced is the evergreen, and contains *Thitkadoh*. The land is turned with a mattock, a manipulation among many others strange to the White Karens, as far as I have been able to observe. Paddy fields were contrived in the ravines. Arrived at the village, I found that it was the last in this direction which practically acknowledged Khon-htee's authority. Khon-htee's agent, whom he had sent to accompany me, said it was not possible to proceed further. There was an apparently well founded rumour that the road to *Brreh*, the basin of the Too stream, above the obstruction had been closed by the people of that district. What is understood by closing the road, is placing some mark, by which a Karen understands that it is not safe to proceed, but which would not deter other persons; and then setting man-traps along the stretch of road or path so marked. The narrow path generally leading along the side of a steep slope, it is difficult to avoid it. I was, however, deterred from making the attempt by reason of the inimical feeling which the act of the *Brreh* people implied, and accordingly stopped at *Taw-koo*. I despatched messengers to Brreh with presents, and an invitation to the headman to come and meet me at Taw-koo; others to *Kyet-poh-gyee* to inform the Deputy Commissioner, the head of the party, and obtain orders on the subject.

March 24th.—Waited at *Taw-koo*. An agent of Imâm's arrived from the Mg-koo-choung, a feeder of the Too-choung, below the obstruction in the river. Having heard that the road was closed, he worked his way up in the beds of the streams. This man had been marking timber that he had bought. He said he had visited the forest above the obstruction, and described it as being uncommonly fine. His mode of expressing his opinion of the rich stock, and the favorable position of the trees was that 150 logs could be turned into the stream in a month with a single elephant. According to his belief there were over 100,000 first-class trees in the forest; 180 trees were killed and some felled with the intention of trying to get them past the obstruction. The attempt was unsuccessful. By blasting a single boulder of not very great dimensions, the stream would be free for timber to pass. There is a great quantity of Thitkadoh in the same forest; pines are also accessible. Toungyahs are

according to his account cut in the regular teak forest for want of any other land to cultivate. There is, however, a large aggregate space which has hitherto escaped. The people of *Brreh* are said to be very poor, and very uncivilized and savage—more so than any others of these parts. They are quite isolated in their valley. They consist of 37 villages and acknowledge no authority outside their own district. The district cannot be as large as the Thonkyagat, but it may be incomparably richer.

March 25th.—*Taw-koo* back to *Kyet-poh-gyee*, 27 miles. Orders arrived in the morning from the Deputy Commissioner to return immediately; which I accordingly did, leaving Khonhtee's agent to meet the Brreh Loo-gyees, and, if possible, induce them to come to head-quarters at *Kyet-poh-gyee*. I distributed a few presents to the headmen of *Taw-koo*.

March 26th.—Remained at *Kyet-poh-gyee*.

March 27th.—Do. do. do.

Heard that there is teak forest on the *Pwon-choong* in large quantity and on both banks. The forest is still intact down to the river banks. The stream is a bad one for floating, chiefly owing to the dense growth of a *Salix* (as I conjecture) out of crevices in the rocky bed. One Ko Oh is at present attempting to clear the stream and bring out timber. He is said to have girdled 5,000 trees. Another man, Boh Nyoh, stated it as his intention to seize and carry off Ko Oh's elephants. Also heard that the timber on the Tee-choung tapers considerably; while that on the Pwon is well-shaped.

March 28th.—*Kyet-poh-gyee* to *Noung-pelay*, 14 miles. Country at first of the character already described on March 20th. Advancing the growth of Thitkadoh became perfectly luxuriant. The tree is largely but not systematically planted in the villages, and thrives wonderfully. A small spare plantation of Thitkadoh was met with. Planting is indicated here for that tree (means of transport fail as before); several pieces of fallow land were enclosed with loose stone walls, and planted sparsely with a *ficus* for the sake of firewood, and with another tree—unknown—for the deposit of lac. One spot was planted with ficus, about as close as an orchard; further on the main road was planted on one side with a row of ficus. Having reached the limit of the

high table land there was a prospect over a plain enclosed between two ranges of hills, and studded with rocky limestone eminences rising abruptly through the laterite soil of the plain. The road descended into the plain by a very gradual slope indeed, and accordingly traversed a great extent of country. The peepul alleys became more and more frequent, and soon the fields were all found enclosed or bordered by rows of these trees. Still lower, the fields were surrounded by ditches and raised banks with trees growing in them. In many places the banks had been planted with young trees so as to form a hedge; the roads led through alleys of trees, had ditches and hedges on both sides, and reminded one forcibly of country lanes in Europe. These fields were carefully tilled, and great attention was evidently paid to the drainage. Gyo (*Scheichera trijuga*) and Yindike (*Dalbergia cultrata*) trees are pretty frequent, and these, as well as many of the trees along the roads and in the hedges, are used for the produce of lac. Reaching the regular plain the ground was laid out for paddy cultivation in a similar manner to that followed in the plains of the Sittang; the several fields being enclosed by a bund about a foot in height. There were no trees here, and it was remarkable that jungle of any kind did not spring up. In the paddy fields were mounds, probably composed of the earth removed in levelling the fields, and which are used for raising other produce, by modifying the moisture of the surface during the floods. In the depressions of the plains a young crop of rice was being raised, the plants were 6 inches to 1 foot high. This was the second crop. The fields were arranged in a very perfect manner, each being absolutely level, with but a few inches of water upon it, and so that a very small supply of water would suffice to irrigate the whole. The stream has been made into a canal; its banks are raised so as to prevent inundation of the rice-fields when the water-level rises, and to allow of the quantity of water being regulated and distributed by small branch canals at pleasure. It is needless to say that no counterpart is found in British Burmah to the intelligence and industry of these cultivators. The lowest elevation in the plains of Noung-pelay is 2,700 feet.

March 30th.—Return march, *Noung-pelay* to *Doh-koh-lay*, 10½ miles. Crossed the Noung-pelay and Ngway-toung plain in a westerly direction; after which the road ran up a narrow valley, merging into the plain from the S. W. The lower part of this valley was occupied with irrigation works of a very elaborate and perfect kind, for the purpose of allowing a second crop of rice to be raised. The upper end of the valley, where it gradually lost itself in the highland—*i.e.*, into undulating country like that already described, and about one thousand feet above the plain—was all terraced for the purpose of storing up the rain-water for the first rice-crop. And further on, wherever the configuration of the soil was favourable, it was terraced in the same way. The Pouk (*Butea frondosa*) tree became very common on this march; it is a good tree for lac. Gyo was observed also, but rarely. The *Sekkoo* tree, of which the Shans make paper, grows here. At the villages in the highland, bamboo (wah-boh) again frequently occurred, and each clump was fenced in as before; the bamboo if not indeed directly propagated by artificial means, is preserved with great care. The planting of Thitkadoh and other trees was noticeable. According to some, lac is deposited on Thitkadoh.

March 31st.—*Doh-koh-lay* to *Chee-shoh*, 9½ miles. Weeds on the tilled soil are not troublesome; the chief are brake fern, and a kind of *Euphorbium*. On fallow ground *Thekay* grass, and another long grass at the highest about 5 feet, but in general 3 to 4 feet according to aspect and exposure. The plantain was found growing wild on bare rocks. Striking west crossed a high rocky range. The country on the other side was much like what we had left, with the difference that the hills were higher and steeper. Amongst the high bare peaks of the range were often basin-shaped depressions clothed with rich *green sward*—a very curious phenomenon. On both sides of the valley trees began to re-appear, but sparsely and greatly stunted. The lower part of the valley was all terraced, and remarkably fresh grass grew in many parts of it.

April 1st.—*Chee-shoh* to *Tee-toung-loo*, 4 miles. Ascended the opposite decline of the last-mentioned valley; trees almost forming forest. A few patches of pine, and above that stunted

forest of evergreen trees. At the *top* of the ascent the evergreen forest lost its stunted character and became luxuriant; the shade was very deep; the moisture sustained by it appeared to have checked the fires, for they had not invaded this part. A few Thitkah trees were observed, but of slow and inferor growth. Elevation 5,520 feet. On the west decline, dense evergreen forest, containing almost no deciduous trees and with clumps of pine and patches of meadow. The pine forest, though producing longer and larger timber than had yet been met, was represented only in clumps. Clearings made in the evergreen forest at this elevation do not cover in with forest in a few years as they do at lower elevations. The trees of the forest, even where close and apparently vigorous, have the appearance of great age, and of having combated with many influences adverse to their growth. An oak, the first of the two noted above, and a Yew (*Taxus*) grow in this forest. Ivy was very common here, and some of the small compositae in the meadows reminded one of daisies.

April 2nd.—*Tee-toung-loo* to *Poh-loh choung*, 8¼ miles. Stunted evergreen forest as before; and intact. Reached elevation of 6,000 feet. Begin to descend, and the character of the vegetation changes. No pines. Pass into a toungyah country of the sort inhabited by White Karens; age-classes of deserted yahs not conspicuous; miles and miles cleared at one time. The fallow ground covered with elephant grass and the usual toungyah scrub, despite the elevation—3,000 to 4,000 feet. Descending further, left the toungyahs and came to forest, transitional to teak forest, and at the bottom of the valley, on the Too-choung the forest resembled the low tree forest which fills in the areas that are not occupied by teak forest or by bamboo in the dry hills of British Burmah. A successful experiment had been made with lac in this place, somewhat east of the Too, at an elevation of about 3,000 feet. There was no trace of teak on the Too, at the point where we crossed; the teak localities did not commence for some distance down the stream. Mr. Manook, the Timber Merchant, here observed that in his opinion 5,000 logs of timber a year could be taken out of the Too forests for 10 or 15 years before the supply would have been exhausted.

April 3rd.—*Poh-loh-choung* to *Kasoung*, 8½ miles. Patches of fairly high evergreen forest in the glades and gullies. Toungyah cultivation of the savage description; the bare yahs covering them in very quickly with the same scrub as at low elevations, although in this place the elevation was as great as 4,500 feet.

On this march and the previous ones the ordinary signs of elevation noticeable by the phases of vegetation were unreliable. In a narrow plain, or silted up valley, there was rice cultivation of a low order—about equal to that pursued in the plain of the Sittang—the natural advantages of the place being turned to but a very poor account; a second crop would have been raised here by the Red Karens.

April 4th.—*Kasoung* to *Kay-choung*, 4½ miles. Evergreen forest along watercourses; otherwise dry bamboo (kyethoung.)

April 5th.—Kay-choung to *Thoukga kat-choung*, 3¼ miles. Forest same as on preceding march. Measured a Thingadoo tree 29 feet in girth.

April 6th.—*Thoukgakat-choung* to *Let-pet-Eng*, 19 miles. Moist bamboo forest; scarcely any yahs for about 4 miles. Then a small tract of country cultivated in the savage manner; the rest of the march toungyah scrub of 5 to 10 years' standing.

April 7th.—*Let-pet-Eng* to *Tonghoo*, 27½ miles. A second crop of paddy might have been raised on Let-pet-Eng as well as on the Eng passed on the 3rd April. Beyond the Eng, toungyah scrub as before; almost no clearings here either (significant fact in the famine country). Final descent into the Sittang valley through some wretched teak forest. In the better parts, traces of Thitkadoh, with thin patches of seedlings of that tree. Then Eng forest, and the other usual links between the forest of the eastern hills and the forest of the great plains.

Report on the Caoutchouc Plantations in Assam and the Yield of Caoutchouc from Ficus Elastica.

By Gustav Mann,

Officiating Deputy Conservator of Forests, Assam.

The last report submitted on this subject contained the results of the first attempt to plant *Ficus elastica* in Assam up to the end of March 1874, and this report will therefore record the results of the planting since that date.

2. The different opinions expressed during the year on the growth and yield of *Ficus elastica* have proved to me that facts regarding the nature of this tree, which I had considered clear and established, because I have had such constant opportunities of watching over and increasing my knowledge of the tree, still remain doubtful to others who have not had the same advantage, which induces me to report in greater detail now than I might have otherwise considered necessary.

Plantation of 1873-74.

3. The planting during 1873-74 was reported in the last report as a failure on account of the lateness of the season when started and drought of that year, whilst the nursery work or the propagation of the plants in spring 1874 was reported as a success up to that date.

4. This report on *Ficus elastica* may conveniently be arranged under three heads as follows :—

(1.)—The propagation.

(2.)—The growth in plantations.

(3.)—The yield.

5. The necessity for forming plantations of this tree having been recognized, no further remarks are required, except perhaps the statement that the protection of the caoutchouc trees in the forests of Assam has again during the year been under the consideration of the Chief Commissioner, and the difficulties of protecting this valuable property prove to be almost insurmountable ; scattered as these trees are through the forests situated in the most inaccessible and unhealthy parts of the province, they have been the prey of tribes living near

these localities, and may now be said to be almost a thing of the past.

6. Plantations will of course not be exposed to these risks, and can be easily managed by a comparatively small staff of Government officers.

I.—The propagation of *Ficus elastica*.

7. Figs are perhaps of all the forest trees in India the easiest to propagate, but for all this the past years' experience has taught us that *Ficus elastica*, both as seedling and cutting, is very susceptible of injury from too much shade or drip from trees causing excessive wet about its roots, which experience cost us a number of young plants, but thus established a fact which is of the utmost importance in the propagation of this tree.

Propagation by seed.

8. The seed sown on the Chardnar caoutchouc plantation on the nursery beds prepared with broken bricks, broken charcoal, and with earth only, as described in paragraph 19 of last year's report, germinated profusely in April 1874, having at first the appearance of cress, the cotyledons being very small.

9. The artificial shading over these seed-beds, however, caused drip and excessive moisture, which proved fatal to many of the seedlings before the cause of the mischief was recognised.

10. The number saved amounted, however, to about 1,200, which were on an average of the undermentioned sizes as they grew :—

On the 27th June 1874, $\frac{8}{10}$ths of an inch.
" 12th August 1874, $1\frac{8}{10}$ths inch.
" 10th September 1874, $5\frac{7}{10}$ths inches.
" 21st April 1875, 2 feet 10 inches.

It should here be mentioned that the last of these was a seedling which had been left undisturbed in the seed-bed, and was exceptionally vigorous in growth.

Germination of seed.

11. The seed sown germinated most freely on the broken bricks, next best on the charcoal, and least on the earth, and as the seedlings

grew, those on the broken charcoal succeeded eventually best of all, whilst those on earth perished, which however is due partly to the large trees left standing in the nursery and the artificial shade got up, for which there proved to be no necessity.*

12. No perceptible difference was noted in the germination of the seed where the whole fruit had been sown and the fruit had been crushed, except that in the former case the young seedlings were very much crowded.

13. They are remarkably hardy as long as they are not exposed to too much shade and drip from above, causing excessive moisture about the roots.

14. During the last cold season most of them have formed a thick tuberous root resembling those of *Epiphytical rhododendron* and *vaccinium*, by which they no doubt are enabled to stand drought during the dry season much better than cuttings.

Seed nursery of 1874-75.

15. During February and March this year a large nursery, measuring 36,000 square feet, has been prepared in the Charduar plantation by raising beds four feet in width and one foot high, and covering them with 160 maunds of broken charcoal.

16. All trees had been cut down in this nursery and no artificial shade of any description has been given to the seed-beds this spring.

17. On these beds six maunds of seed were sown, the first of which germinated on the 18th April, and they look remarkably well.

18. A small quantity was also sown on earth alone to give this mode of raising seedlings a further trial, since it is more economical than where charcoal is used.

19. About 400 seedlings were brought in by "Miris" which had evidently germinated on the ground, and these men affirm that the seed of *Ficus elastica* germinates freely on the ground wherever there is sufficient light.

Seedlings brought in by Miri villagers.

Since these seedlings were fetched from the Akha hills immediately north of the Charduar plantation, it is easily understood that the seed

* See also Appendix. The Editor.

will germinate on steep hill-sides where there is light whilst for the same reason in the dense evergreen forests along the foot of the hills this is a very rare occurrence.

That the seed of *Ficus elastica* will germinate and grow on the ground is further borne out by the young trees met with in tea gardens where the ground is kept clear.

20. At the Kulsi plantation in the Kamrup district seedlings have been raised in the same way on a small scale with much the same results.

Propagation by cuttings.

21. The cuttings made in spring 1874, and reported on in paragraph 18 of last year's caoutchouc plantation report, suffered in a similar way from drip from the artificial shade and trees left as a precaution in the nursery, which has taught us the same lesson with regard to cuttings as with the seedlings.

22. This experience after all was very cheaply bought, since the cost of the nursery was trifling, and we managed to save 2,000 cuttings which were sufficient for the plantation.

Time for making cuttings.

23. The best time for making cuttings in Assam is no doubt from the middle of January to the end of May, it depending on the rainfall during the latter three months which of the cuttings will do best; those made in 1874, after May, failed almost entirely.

24. The earlier in the season, before the young shoots to be used have started growth, the better chance they have of success, and at this time young terminal shoots will grow well; whilst after the trees from which the cuttings are taken have commenced growth, which happens about the end of January, the lower somewhat harder portion of the young branches succeeds better, than the soft terminal shoots.

Description of cuttings.

25. Only young and vigorous branches from lopped trees are used, and they are cut 1′—2′ in length, and are put three inches in the ground; all scrubby branches from old trees almost invariably fail.

26. The branches from young trees are still better than those of lopped trees, but these are rarely to be had now.

After our young trees are two or three years old, they will furnish any quantity of shoots best suited for cutting.

Nursery for cuttings of 1874-75.

27. The making of the cuttings this spring was begun in the end of January, both at the Charduar and Kulsi plantations, and in the former it was continued until the 19th of March.

28. The beds for the cuttings were raised one foot high, all the paths between the beds being so constructed as to prevent water resting, and as an extra precaution the earth at the Charduar plantation was mixed with river sand since it is rather clayey, retaining moisture longer than suits the cuttings.

29. The nursery for cuttings in the Charduar plantation in the Darrang district, prepared in this way, measures 25,200 square feet, and at the Kulsi plantation in the Kamrup district a small nursery sufficient to grow the cuttings for an extension of 30 acres was prepared and planted.

30. The same artificial shading of grass was employed as last year, but was removed every afternoon and not replaced until about 9 o'clock in the morning, by which more light was ensured to the cuttings during part of the day, and they had the benefit of the night dew.

31. On the 7th of March the first rain fell at the Charduar plantation and continued for some-time, which opportunity was taken advantage of to harden off the cuttings and to remove the artificial shading entirely; until rain fell all were watered twice a day.

32. The success of the harder cuttings has been general, whilst amongst the soft young shoots there have been many losses.

Number of cuttings.

33. On the whole the propagation from cuttings has this spring been most successful, there being at the Charduar plantation 16,401 cuttings alive out of 21,213.

34. This is 22 per cent. of failures, which is insignificant, considering that many of the cuttings were necessarily still inferior, young trees, which are the best for cuttings, being extremely scarce.

35. At the Kulsi plantation there are 1,790 cuttings alive and doing well, which is also much more than we require for this year's extension.

36. A small nursery has also been prepared with equal success at the Bamuni hill plantation in the neighbourhood of Tezpur for an extension of 10 acres this year.

II.—THE GROWTH IN PLANTATIONS OF *Ficus elastica*.

37. The first plantation of *Ficus elastica* in Assam extended over 18 acres, and was started on the right bank of the Kulsi river, about 30 miles west of Gauhati in the Kamrup district, adjoining the experimental teak and sissoo plantations, which are the head-quarters of the officer in charge of the Gauhati forest division.

38. The experiment became a failure from reasons explained in last year's report on caoutchouc plantations, but the old lines have been replanted and 17 acres added, which makes the total area under plant in the Gauhati division 35 acres.

The Kulsi caoutchouc plantation.

39. The method of planting adopted in the Kulsi caoutchouc plantation is the following:—

Lines 20 feet in width and 50 feet apart are opened out in mixed plain and savannah forest, and the trees are planted out on those lines at distances of 25 feet.

40. The plants in this plantation were examined by me on the 26th of April, and the countings showed 2 per cent. of failures, which were filled up the same day. Nothing could surpass the healthiness and vigour of the young trees, whose only enemies are the deer, which has made fencing necessary, but the plants will soon have grown beyond the reach of them.

41. Besides this, 30 acres have been prepared for planting during last cold season, but as the weather up to the end of April was very dry, the planting is only being done now, and these 30 acres have therefore not been brought on the register of area of caoutchouc plantations before the end of the financial year 1874-75.

42. This locality was not chosen for the first plantation, because it was well suited, but on account of the season being far advanced, and there was a forest officer on the spot to look after it.

43. Kamrup is, compared with other districts in Assam, dry, and it is not intended to have caoutchouc plantations on a large scale in this district on this account, since the yield will be proportionately small.

44. All land in the Kulsi plantation reserve not suited for timber plantations will thus be made use of for caoutchouc plantations, which will make the total area about 100 acres. This will furnish a field for experiments in tapping and enable us hereafter to draw comparisons between the yield of caoutchouc from trees in this district and that from the more favourably situated Charduar plantation at the foot of the Himalayas in the Darrang district, 18 miles north of Tezpur.

The Charduar caoutchouc plantation.

45. The latter plantation extended over an area of 180 acres in the year 1873-74. The plants in this plantation were examined by me on the 21st of April 1875, and the countings made all through the plantation showed 3½ per cent. of failures.

In addition to this 140 acres more have been got ready, and another 60 acres are in course of clearing for plants.

None of this area has, however, been planted, since the rains will be more suited for this work, and no additional area has for the above reason been brought on the register of area of caoutchouc plantations before the end of 1874-75.

46. The method of planting adopted in the Charduar plantation was the following:—

Lines, 20 feet in width and 100 feet apart, were opened out through lower hill forest, and trees were planted out on these lines at distances of 50 feet.

47. The width of the lines proved insufficient as soon as the rains set in, and the excessive shade and drip from the trees on either side of the line proved injurious, and in many cases fatal to the plants.

48. The plantings on split stumps of trees and in earthenware rings, placed with the widest opening on stumps, was suggested by the Chief Commissioner and proved very successful in low situations, counteracting the excessive wet on the ground, but vigorous growth was not insured until more light was admitted.

49. All the lines of last year's plantation were therefore opened to 40 feet in width, and the effect on the young trees has already been most beneficial, so that, although it is only the commencement of the growing season, nothing could surpass the vigour and healthy appearance of the trees, and so far as the planting on lines opened out through the forest goes it certainly is a perfect success.

50. The ground on these lines is not cleared except just around the plants, but the opening out of bridle paths has become necessary to save time in going over the plants, but since frequent inspection is the only way to prevent any vacancies remaining in the plantation.

51. The growth of low jungle or scrub in these lines has neither been such as to necessitate subsequent clearing.

52. The opening out of these lines to double the width has however doubled the cost of this, the chief work in the plantation, and besides the daily increasing demand for labour on the tea gardens has induced the planters to pay absurdly high wages, thus making local labour, which only is suited for the caoutchouc plantation work, scarcer every day.

53. For this reason experiments have been started to plant the young trees in strongly-made cane baskets and to place these in the forks of trees.*

Planting in the forks of trees.

54. Only seedlings are used for this mode of planting, since they soon form thick tuberous roots and thus become more fit to combat with the comparative dryness to which they are exposed in the tops of trees in the dry season.

55. The first of these were planted on the 25th of January in trees near the nursery, and on the 21st of April they looked everything that could be desired.

56. This mode of planting wood only necessitate a small bridle path being opened through the forest instead of lines 40 feet in width, and is estimated to reduce the cost of the creation of caoutchouc plantations on a large scale, including survey,

* This system was first suggested by Dr. W. Schlich in January 1873, and advocated by him ever since.—THE EDITOR.

formation, conservation, roads, buildings and salaries, from Rs. 10 to Rs. Rs. 5 per acre.

57. The only objection to this plan is the difficulty of inspection, and without constant examination of the plants no satisfactory results can be reckoned on.

This I hope to overcome by having every line numbered, and every tree on which a caoutchouc plant has been placed, marked.

These lines will then be regularly gone over at least once in two months, and the result placed on record in the plantation journal.

After a year or two the plants will be sufficiently large to render the climbing of trees unnecessary, which latter will be the only difficult task in the examination of the plants, but it is considered of such importance during the first year or two, as to justify high pay to the men who have to do this work.

58. It is hoped to bring during these rains 50 acres under cultivation in this way, and thus to obtain results on as early a date as practicable.

59. This mode of growing *Ficus elastica* it is intended to introduce only on the ground of economy and the growing scarcity of labour, and not because it is believed that this tree grows naturally as an epiphyte only, for trees which germinated on the ground are said to be not at all rare in the Akha hills north of the Charduar plantation, and the caoutchouc collectors who go beyond the British boundary into these hills, will have it that such trees, although few in number, grow larger than those which commenced life as epiphytes between the branches of other trees.

Ficus elastica grown in the soil.

60. I myself have never seen but one tree which had undoubtedly germinated on the ground, but then the want of light in the dense forests along the foot of the hills renders it impossible for trees to grow in this way as proved by our seed experiments.

61. The only one specimen above mentioned which ever I saw had a true stem, cylindrical in shape and measured 16 feet in girth 30 feet above the ground, but this had not prevented

the tree from throwing out great numbers of aerial roots descending from branches 50 feet above the ground.

Some of these aerial roots measured 6 to 8 feet in girth at distances of 20 feet from the stem, and had established themselves firmly in the ground like the tree itself.

62. Neither does *Ficus elastica* in Assam, if planted in the ground, remain smaller or more destitute of large aerial roots than trees which grew first as epiphytes, as has been stated.

63. The measurements given below will show that the epiphytic growth of a *Ficus elastica* is not by any means essential, for after all is done and said this tree is only epiphytical in early life for a comparatively small number of years, after which it has its roots in the ground like any other tree.

64. Natives will have it that the aerial roots of young *Ficus elastica* in the Charduar reach the ground in the third year.

65. To corroborate the above, and to ascertain the distances at which the young caoutchouc trees should be planted, enquiry was instituted regarding the age of the largest tree planted in Tezpur, and measurements made of this tree, which were as follow :—

Age of tree	32 years.
Height of tree	110 feet.
Diameter of crown	140 „
Circumference of the centre mass of aerial roots surrounding the stem ...	70 „
Distance of outermost aerial roots from stem	30 ..

There were over a hundred aerial roots, the five largest of which measured each respectively 6 feet, 4 feet, 4 feet, 3½ feet and 3 feet in girth, 5 feet above the ground.

66. These measurements show the size and rapid growth of *Ficus elastica* planted in the ground in Assam, which in the forests at the foot of the hills must be even much greater than in the station of Tezpur, and is not less than that of the epiphytic trees.

Distances for planting.

67. As the roots spread out in the soil very near the surface to a distance of 150 feet and more, and form a thick network, it is considered

close planting will seriously interfere with the free development of the roots and growth of the young caoutchouc trees, and unless vigorous growth is ensured no yield of caoutchouc can be expected.

68. It is however intended to have the trees on all the area at present under cultivation planted at 25 feet distances in the lines instead of 50 feet, so as to have a number of young trees available for experiments in tapping to ascertain the yield from young *Ficus elastica*. It is thus intended to have every alternate tree killed by tapping at the time they begin to interfere with the growth of those it is intended to let grow to maturity.

69. The tree measured in Tezpur is exceptionally large, and to all appearance not only healthy but luxuriant, but for all this it yielded next to no caoutchouc when permission was given by the proprietor to one of the traders in the bazar to tap it.

70. This latter fact I do not attribute, as Dr. Schlich, the Conservator of Forests, Bengal, and Dr. King, the Superintendent of the Calcutta Botanical Garden, do, to the fact of the tree having originally been planted in the ground, but to the locality in which it grows, which will be further remarked on under the head of yield of *Ficus elastica*.*

Selection of localities for plantation.

71. The above fact of this luxuriant tree in Tezpur not yielding any caoutchouc, and similar results of experiments in tapping trees in Gauhati made by me, point to the great necessity for a most careful selection of the localities for caoutchouc plantations, and no greater mistake could possibly be made than to start plantations of *Ficus elastica* in any part of Bengal with the view of

* This remark of Mr. Mann's is not quite correct. In the report to which Mr. Mann refers here, Dr. Schlich states that the two most important points are—

1*st*.—The way in which the tree has been reared, whether as an epiphyte, or from a cutting or seedling reared in the ground; and

2*nd*.—The greater or lesser moist dampness of the climate.

After stating that he considers the epiphytic trees as likely to reach larger dimensions and to have more and larger aerial roots, and to be consequently more capable of yielding India-rubber, he continues: "Although *Ficus elastica* will grow in the dryer "parts of Bengal, still to ensure its growing luxuriantly and its being able to spare "surplus milk for rubber, it is necessary that it should vegetate in a warm, moist "atmosphere, such as is found in Assam and Sikkim, especially along the foot of the "hills and in the side valleys up to an elevation of 1,500 and perhaps 2,000 feet. "Moreover it appears to me that the aerial roots will only reach the ground and attain "a good size where the tree grows really luxuriantly. To sum up then, I am of "opinion that it would not pay to rear *Ficus elastica* in Bengal, except in warm, moist, "localities, especially in the moister parts of Assam; and, secondly, I have very serious "doubts, whether trees reared in the ground will ever yield a large return, even if "planted in the natural home of the tree."—THE EDITOR.

producing caoutchouc, as suggested by Dr. Henderson, or to draw any conclusions regarding the way it should be cultivated from the appearance of trees planted in Bengal, for although the trees will grow in any part of Bengal, caoutchouc there would be next to none.

72. To insure a sufficiently large area of land being maintained as forest for caoutchouc plantations, proposals for the reserving of an area of about 140 square miles in the Chardwar, north of Tezpur, were submitted in spring 1873, and are now under the consideration of the Chief Commissioner.

73. Experiments of planting *Ficus elastica* on a small scale in grass land are carried on by order of the Chief Commissioner in the neighbourhood of Tezpur, to obtain results hereafter regarding the yield of caoutchouc from trees in this locality, as compared with the yield from trees at the foot of the Himalayas.

74. Ten acres were thus brought under cultivation by planting at distances 25′ × 25′, no vacancies exist, and the plants, though small as yet, look very healthy.

75. Nahor *(Mesua ferrea)* has been planted between the young caoutchouc trees.

76. Close planting in this case is resorted to, to bring about on as early a date as possible a perfect cover on the land and thus extirpate the grass, insure the formation of vegetable mould, the moisture of the soil, and the surface sufficiently open to atmospheric influences, which conditions are insured in the Chardwar plantation by leaving part of the forest standing.

Conditions required for the growth of *Ficus elastica*

77. The general conditions for the healthy and rapid growth of the young trees of *Ficus elastica* as detailed above are these:—

(*1st.*)—Perfect drainage about its roots and looseness of soil so as to admit the air readily, the geological composition of the soil not affecting the trees as long as the above conditions are fulfilled, but it should not be gravel or sand, since all caoutchouc collectors state that it produces much smaller quantities even in the best localities.

(*2nd.*)—Plenty of light without decreasing the moisture of the air by the admission of it.

(*3rd.*)—Heat and moisture combined, or what is commonly termed a close and steamy atmosphere.

78. The districts in Assam suited for caoutchouc plantations are—

1. The Darrang district.
2. The Naga Hill district.
3. The Lakhimpur district.

79. The south of the Cachar district would be suited, but the comparatively unsettled state of the Looshai boundary would not render such a measure for the present at least advisable.

80. None but the moist evergreen forests along the foot of the mountains should ever be chosen for caoutchouc plantations.

81. In the Kulsi plantation no separate establishment has been entertained for this particular work, but the caoutchouc plantation is debited with one-fourth of the cost of the whole plantation establishment.

82. The area of the caoutchouc plantation at the Kulsi at the end of 1873-74 was 35 acres, on which an expenditure of Rs. 377-13, or Rs. 10-12-8 per acre, had been incurred up to that date.

The area got ready for planting last year at the Kulsi is 30 acres, which, together with improvement and conservation of the plantation of 1873-74, cost, during the financial year 1874-75, Rs. 605-14, or Rs. 15-2-1 per acre for two years, which has become so high on account of the nursery, the greater part of which, and especially the seed nursery, was destroyed by floods last year, and the great difficulty in procuring suitable branches for cuttings in this locality.

Establishment, area, and cost of the Charduar caoutchouc plantation.

84. The establishment entertained at the Charduar caoutchouc plantation, including the small experiment near Tezpur, was the following :—

1	Mohurir on	Rs.	14	per mensem,	for 9	months.
1	,,	,,	20	,,	,, 2	,,
1	Watcher on	,,	7	,,	,, 9½	,,

85. The area of the caoutchouc plantation at the end of 1873-74 was 180 acres, on which an expenditure of Rs. 415-3-6, or Rs. 2-4-10 per acre, had been incurred up to that date.

86. The area planted in 1874-75 was 10 acres near Tezpur, and 140 acres have been got ready for planting at the Charduar plantation.

87. In addition to this, all the lines of last year's plantation have been opened out to double the width, bridle paths been opened out along each line, the plants been fenced in, and large nurseries for cuttings and seedlings been prepared, the cost of which, during the financial year 1874-75, was in the abstract as follows :—

	Rs.	A.	P.
Demarcation	43	11	0
Formation	2,084	3	0
Protection from fire	24	12	0
Improvement and conservation ...	505	6	3
Fencing and enclosing	193	9	6
Roads and bridges	205	10	0
Buildings and offices	607	2	0
Salaries	232	10	0
TOTAL ...	3,896	15	9

or Rs. 15-1 per acre for two years, which is also above the average cost on account of buildings, roads and bridges, as well as the large nurseries which had to be prepared at starting.

88. For all this the cost of the caoutchouc plantations, even at Rs. 10 per acre as now estimated, is very small compared with other plantations.

89. The cost per acre if planted in baskets to be placed in trees is estimated at Rs. 5, but as the experience gained in the latter mode of planting is as yet small, this estimate must be considered subject to correction hereafter.

Supervision of the caoutchouc plantations.

90. The head-quarters of the divisional forest officer in the Gauhati division are on the Kulsi plantations, and that of the officer in charge of the Tezpur division, at the Barolighat, a distance of 5 miles

from the Charduar plantation, so that in either case competent supervision throughout the year is given to this work.

III.—Yield of *Ficus elastica*.

Yield in different localities.

91. Amongst the different conditions on which the yield of the *Ficus elastica* depends stands foremost the locality in which it is grown.

92. When first enquiring in 1869 from the caoutchouc collectors into the yield of the tree in different localities, I was informed that it would yield most in the hills, next best immediately at the foot of the mountains, and that this yield diminished according to the distance from the hills the caoutchouc tree was growing in the open country, or even on the banks of the Brahmaputra, where, I was informed, it would yield little or none.

93. It was in accordance with this information that the Charduar plantation was started as being in one of the most favourable localities in Assam.

94. Subsequent and frequent enquiry has been made on this subject, and the collectors now say they get more at the foot of the mountains than in the hills.

95. Whichever is the correct statement, the difference in quantity yielded by trees growing in the plains along the foot of the mountains and those growing on the lower hills is but trifling, if not entirely imaginary, whilst as the forests along the foot of the mountains are left and the open country is entered, the quantity diminishes very rapidly until on the banks of the Brahmaputra, in the stations of Tezpur and Gauhati, as mentioned above, trees which had not been tapped before were tapped without yielding any caoutchouc worth speaking of, thus substantially proving the above information to be correct.

Yield from stem and roots of *Ficus elastica*.

96. The next question raised during the last year is, will *Ficus elastica* yield equally if tapped from the stem or aerial roots? On this point, in Assam at least, no doubt ever existed.

The collectors state that there is no difference whatsoever, but that if they dig up the ground and thus get at the roots in the ground, that the latter will give more.

97. My own observations are that caoutchouc collectors will go to the utmost extremity of the branches at the risk of their lives to procure caoutchouc, and that the quantity will only vary according to the place first attacked ; if this is commenced at the upper branches the greater quantity will be obtained from there; if at the roots in the ground, as, I regret to say, is done in the most cases, the largest quantity will be obtained from these.

98. I have always looked on the formation of aerial roots as one of the greatest advantages in favour of the cultivation of *Ficus elastica*, since the facility with which these are thrown out enables this tree to recover itself much faster than other caoutchouc trees with only a single stem.

99. I do not wish to affirm by the above remark that I do believe in surplus milk, or that a vigorous tree receives through one stem less sap than through many stems; on the contrary, a tree in health will always produce as much sap as it requires, no matter if through one or many stems or roots, but if by tapping the actions of roots or stem are interfered with or rendered impossible, *Ficus elastica* will, by making new roots, adjust this quicker than a caoutchouc tree with a single stem only.

100. On the other hand, the great number of aerial roots enable the collector to overtap a *Ficus elastica* more than any other caoutchouc tree, as the surface exposed is greater, but this can be easily controlled in the plantations when the trees are ready for tapping.

101. If the *Ficus elastica* is planted in the ground, or germinates in the fork of a tree, it makes but little difference to the size or number of aerial roots formed after, especially if grown as is done in the Charduar plantation, where part of the forest is left standing between the lines of caoutchouc trees, by which an excessively steamy atmosphere is ensured: in such localities the aerial roots will always correspond in size and number to the size of the tree.

102. A single stemmed *Ficus elastica*, without any aerial roots of large size has never been seen by me in Assam, except in stations where every boy takes a pleasure in hacking about the tree, wherever he can get at it.

103. The size, which *Ficus elastica* will reach if planted in the ground (in Assam) has been exhibited in the measurements given above of the oldest planted tree in Tezpur.

Yield per tree of *Ficus elastica*.

104. After a year or two when the natural trees in or about the Chardnar plantation have recovered, we shall be able to collect accurate information as to the yield per tree.

105. The information we have about the yield of trees and climbers producing caoutchouc in other parts of the world is so vague, that even after we have ascertained the yield of *Ficus elastica* we shall not be able to draw comparisons.

106. It has been stated that a tree of *Castilloa*, 18 inches in diameter, will give 20 gallons of milk; this certainly *Ficus elastica* will not give, but I must admit that my knowledge of vegetable physiology does not permit me to believe this of *Castilloa* either, at least not oftener than once.

107. As to the *Urceola elastica* yielding caoutchouc in the third year, *Ficus elastica* will do this also, but for all that I consider it would be very imprudent to tap trees before the age of 20 years.

Time for tapping.

108. The most favourable time for tapping certainly is January, February, and March, when the milk runs abundantly, and is superior to that collected in the rains.

Varieties of *Ficus elastica*.

109. There are two varieties of *Ficus elastica*, the "Bogi-Bur," and the "Shika-Bur," and the former of which is said to be slightly superior, but the difference is not such as to render it advisable to confine planting to this variety only.

Manufacture and collection of caoutchouc.

110. There is no doubt room for improvement in the manufacture and collection of caoutchouc, and experiments have been started with a view to ensure this.

111. The task which forest officers in Assam have set themselves to perform, however, is in the first instance to propagate and grow *Ficus elastica*, which has been done most successfully so far, considering the past year was only the second year of these experiments, and the manufacture of superior caoutchouc

will be tried during the coming season as far as the exhausted state of the trees permits.

112. The climber in Cachar giving caoutchouc was searched for and examined; good botanical specimens could not be got at the time, but it is hoped will be procured during the coming year.

The Cachar climber yielding caoutchouc.

The quality of the caoutchouc is extremely inferior, there being no elasticity at all in the substance.

APPENDIX.

From Dr. W. Schlich, Conservator of Forests, Bengal, to the Secretary to the Government of Bengal, No. 87C, *dated Darjeeling, the 26th May* 1875.

In reply to your endorsement No. 2013, dated 17th July 1874, forwarding letter No. 736, dated 7th July 1874, from the Government of India, Department of Revenue, Agriculture and Commerce, I have the honour to submit, for His Honour the Lieutenant-Governor's information, the following remarks regarding the raising of seedlings of *Ficus elastica* in nursery beds, as carried out by Mr. Gamble, Assistant Conservator of Forests, in charge Darjeeling Division.

2. At Bamunpokri nine nursery beds were prepared, three with common garden soil, three with broken bricks, and three with charcoal, and all intersected by irrigation trenches, thus keeping the soil thoroughly moist by percolation. The seed was collected in September 1874, and sown in that month and in October, partly in whole figs, and partly crumbled up by the hand. The beds were then shaded by thatch, raised two feet above the ground on the south, and three feet on the north, and the sides were closed in with mats which could be removed at will.

3. From four to six weeks after sowing the seeds germinated profusely, best of all in the garden soil; next best on the broken bricks, and last, though still pretty well, on the charcoal; they have thriven well, and are now up to five inches high, with leaves up to two inches long. On the whole, therefore, it may be said that little or no difficulty has been experienced in raising seedlings of the *Ficus elastica*. When of a sufficient size they will be planted out, some in the ground and some on useless forest trees, and I hope to report further on the result of the experiment after another year.

Arboriculture in its relation to Climate.

Much has been written of late on this subject, and with special reference to *Eucalyptus Globulus*. Still the subject does not seem to have been exhausted, and the following papers will doubtlessly be found interesting.—THE EDITOR.

From Her Majesty's Secretary of State for India, to the Government of India.

I forward herewith, for the consideration of your Lordship in Council, copy of a memo. by Lord Mark Kerr on the Delhi Sore, and request that I may be informed whether the attention of the Sanitary Officers of your Excellency's Government has been attracted to the statement regarding the alleviation of the disease by planting trees and grass, and whether any report has been received on the subject.

Memo. by Lord Mark Kerr, on the Delhi Sore, republished from the "Indian Medical Gazette."

"Before my arrival in India, I had heard of the existence of "certain boils and sores in many Eastern Cities which having "once been places with enormous population and all the "acquirements of wealth and luxury, well drained, well watered "and adorned with numerous trees and gardens, had, in the "process of centuries, become, for the most part, desert wastes, "their canals and water-courses choked up, and their only "vegetation unwholesome weeds. I knew such to be the case at "Bagdad, Alleppo, and other places. When I arrived at Delhi, "I found the inhabitants, and those with whom I, as Brigadier-"General, was most concerned, the garrison both European and "Native, to a great extent suffering from boils, sores and un-"sightly fungus-looking growths on their hands and limbs; "and I found Delhi within the walls a surface of barrenness, "covered here and there for the space of two miles in length "and 500 yards in breadth, by foul weeds or heaps of demolished "buildings, with wells and water-ducts choked up. I informed "the Viceroy and the Commander-in-Chief of the state of

"things, and of my intention to plant trees and grass so as to "remove the cause of evil. I had previously obtained the Lieute-"nant-Governor's sanction, and funds sufficient for the purpose.

"One circumstance confirmed me as to my opinion of the "cause of evil, and induced me to make a trial, which still "further strengthened this opinion. The men of the Cavalry "Regiment stationed near the Cabool gate amongst trees and "grass were entirely free from boils and sores, and I sent out "those of the rest of the garrison of the 82nd Regiment and "the 12th Native Infantry, unfit for duty from the sore, under "canvas amongst the trees and verdure of the old Cantonment, "with the most satisfactory results, the worst sores becoming, "after the first week, greatly ameliorated, and the slighter "cases returning to duty day by day at the same time.

"I continued planting as the ground became cleared, and I "restored an aqueduct which still takes water to gardens in "Durriangunge from the further side of the Chandnee Choke.

"I left India in January 1864. I informed His Royal High-"ness the Duke of Cambridge on my arrival in London of "what I had done, and of my sanguine hopes of success. Since "then I have from time to time heard such satisfactory "accounts of the growth of the trees and gardens in Delhi, and "the gradual diminution of the cases of sore, that I resolved, "on hearing that the Commander-in-Chief was to hold a Camp "of Exercise at Delhi to come out and see for myself.

"I am most truly rejoiced to find the disorder has, at the "end of these years, almost disappeared from Delhi. I am "aware that other reasons are now urged to account for the cure "of the sore, but not even the plea of the stamping out of the "contagion can account for the non-appearance of fresh cases "amongst either the Native or European population.

"Without wishing to claim credit for myself in the matter, "I am very anxious that the experience of this City of Delhi "should be made known for the benefit of other regions in "India where the like pure irrigation and draining with judi-"cious planting and gardening would, I firmly believe, remove "not only sores and such like evils, but prevent the approach "of more serious and even fatal scourges."

From Surgeon-Major E. Morton, H. M.'s 29th or 2nd Belooch Regiment, to the Deputy Surgeon-General, S. D., Kurrachee.

SIR,

IN obedience to your memo. No. 1018 of 1873, to which my attention has recently been called, directing Medical Officers in charge of Native Troops to conduct a careful enquiry into the nature and causes of Sind Sore, I have the honor to remark, that I have had no opportunity of instituting a specific investigation into the pathology of the disease. I am therefore unable to offer any opinion regarding the nature and causes of Sind Sore, whether it be local or constitutional, parasitic or otherwise; nor am I in a position to trace any inter-relationship between the form of ulcer known as "Sind Sore" and the so-called "Delhi Boil."

2. The object of the proposed enquiry being two-fold, 1*st*, to obtain a more accurate knowledge of the character, to elucidate the origin, to direct the treatment, and to accomplish the prevention of Delhi Boils and Sind Sores; and, 2*nd*, to test the accuracy of Lord Mark Kerr's conclusions, so forcibly expressed in his memo. to the effect that by the judicious planting of trees and grass, the opening of old canals, water-courses, &c., or in other words careful attention to general sanitation, the disease called Delhi Boil may not only be mitigated, but altogether eradicated. The remarks of Lord Mark Kerr on this point having a special and specific bearing, I cannot avoid the conclusion that his Lordship has attempted to prove too much. The measures which he took to mitigate the evil of the Delhi Boil were of general, rather than special sanitary arrangement; in fact I may say a system of sanitary procedure based on common sense and common experience, attention to which will undoubtedly greatly influence the development, the prevalence, and the persistence of any disease. For I need scarcely remark that in proportion as the body is weakened and the vital powers lowered by surrounding insanitary conditions, it yields the more readily to the pernicious influence of morbific agencies from whatever source proceeding.

3. Viewing the subject in a general sense and in the light of the belief expressed in the latter portion of the memorandum,

that "the like pure irrigation and draining with judicious planting and gardening would, I firmly believe, remove not only sores and such like evils, but prevent the approach of more serious and even fatal scourges," Lord Mark Kerr's words have a wide significance and a most important bearing, especially in connection with paludal malarious fevers, the most prevalent, and in their ulterior consequences the most fatal diseases of India.

4. The practical connection of agriculture with health and strength, with sickness and mortality, is inseparable from a comprehensive consideration of the public health. It has been operatively exemplified in England where diseases usually attributed to marsh miasm, and which were formerly so destructive to life, numbering James the 1st and Oliver Cromwell as victims, have almost disappeared, owing to land-drainage, town-sewering, and improved methods of agriculture. So with other countries I need not instance, where like salutary and beneficial results to health have flowed from carrying into effect enlightened principles of agriculture and sanitation which go hand in hand.

5. Agriculture, used in its extended sense, including every description of territorial improvement, comprehending irrigation, embanking, road-making, drainage, arboriculture, &c., is every where the most powerful improver of climate. Wedded as the natives of India are to the primitive customs of their forefathers; bound by immemorial usage to their rude but time-honoured system of cultivation, a policy of improvement is alien to a people so conservative, who have practised agriculture and nothing else for ages. Considerations of profit or of health are alike disregarded through popular ignorance, indifference, and the accumulated prejudices of centuries. It therefore follows that agricultural improvement, whether viewed in its life-sustaining or in its life-preserving aspect, devolves as a special duty on the State. The subject is one of vital importance at the present time, when measures to meet the requirements of the people and to avert famine are attracting much public attention. Happily it cannot now be said, as in the case of so many former famines, that "hopeless anguish poured its groan, and languid want retired to die."

6. It will probably be conceded that in all public measures for material advancement, safety to health is the first thing to be sought, and profit must come afterwards. It will further be conceded that irrigation is a matter of life and death to our Indian subjects, whether viewed in a hygienic or in a food-producing light. But how stands the question in India in relation to our great reproductive public works? Do not the most pernicious results flow from looking at irrigation entirely with a view to its main end, and that no part of its efficiency for that end should be sacrificed for promoting any other end, however excellent?

7. The problem of sustaining an ever-multiplying population pressing with an ever-increasing intensity on a soil with stationary powers of production has called forth in this country a policy of internal development which in itself involves dangers that have not been fully recognized. Irrigate the land any how and produce plenty is the policy of the day, but the fact that a large water-supply without the provision of adequate drainage outlets means a high ratio of sickness and mortality seems to be considered of little moment. There is no reason why increased food-production and pestilence should march together, if irrigational works are projected on well-known sanitary principles. There is no reason why the blessing of material prosperity should be attended by the curse of disease. But that the latter follow the former is painfully apparent on too many of our irrigational works, nowhere perhaps so disastrously as in the Godavery Delta. There water flowed in abundance from the great system of works in operation, but it flowed as a plague over the land. There was one fatal defect in the scheme, sanitary laws had no place in it. A wealth of water was poured forth without the provision of sufficient escape-channels for its removal, and the result was pestilential stagnation, which generated an atmosphere of death throughout the district. To stay the pestilence, the Government of Madras have sanctioned a large annual expenditure on "special works of drainage" for, in the words of the Government Resolution on the subject, "remedying this most crying evil, whereby at present the gift of financial prosperity bestowed

on the District is coupled with the curse of disease." Epidemic disease, the expenditure of a lac of rupees annually, and the temporary remission of taxation to the infected villages, are the results of irrigation viewed in the sole light of material advancement. This is not a solitary instance: there are many districts where the same results, though not so marked and fatal, follow in their silent uninterrupted course.

8. The duties of the Government of India being to a certain extent paternal, the obligation is imperative to study the great changes which are taking place adverse to the salubrity, and to the public and private hygiene of irrigated districts. Day by day it becomes more imperative, for population follows in the wake of irrigation, and unless engineering science is directed to the sanitary aspect of the subject in providing the most efficient, the most wholesome, and the most economical drainage escape-channels, the pest of endemic disease, occasionally relieved by fatal epidemics, must always hover over the land. But apart from the hygiene of the subject, a more extended system of drainage is called for as a question of profit, for where irrigation has been long practised the soil becomes water-logged, crops deteriorate, and sterilization ultimately ensues. We might draw many useful lessons from irrigation as practiced in Southern Europe, where Prefects, Syndics, and Tribunals of waters are specially charged with a general supervision of the interests of the community: where the natural drainage of the country is not allowed to be interfered with by the new irrigation, and where irrigators are bound to drain off the waters which percolate through the lands and swamp grounds at a lower level. There every other consideration must give way to the health, happiness, and well-being of the community. There the perfection of irrigation means the highest standard of production, with the lowest ratio of disease. In Northern Italy rice grounds are ordered to be kept at a distance of 14 kilometres, or 8·7 miles from the large cities to 1 kilometre, or 1,094 yards from the smaller towns. Even in Spain, the most unprogressive country in Europe, where rice cultivation produces much sickness, it is not unfrequently forbidden altogether, or restricted to certain places. It is true

irrigation is not carried out in Southern Europe on the gigantic scale of this country, but the greater the danger to human life from the greater density of population in India, the greater should be our sanitary preventive measures.

9. The cumulative and persistent pernicious action of paludal malaria is too apparent on all sides in the mental and physical degeneration of those constantly exposed to its influence to require observation. But I may ask how many fever-stricken spots are there in the districts where disease revolves in the same calamitous monotony, yet we have made no attempt to strike at the root of the evil,—nay we aggravate it by planning our irrigational works in opposition to the laws of health. We cannot plead ignorance of the subject, for we have long had a right understanding of the causes of paroxysmal malarious fevers, so varying in their nature, so general and complicated in their influence on the system, that almost every organ is implicated, almost every function suffers, for they have essentially the same fatal effects, whether viewed in their tendency to destroy life speedily, or in their remoter organic results.

10. Sanitation has not been allowed to fall behind the science and requirements of the age in our large cities, at least many salutary and beneficial reforms have been effected. But how stands the question in our rural districts? Have we not forgotten that nothing more marks India from Europe than the greater density of the rural, as distinguished from the urban population. I would ask what artificial means of health-amelioration and disease-prevention have been introduced for this vast rural population? What special measures having health as the sole end, aim and object have been organized throughout the land? Measures of the nature of swamp drainage, sub-soil drainage, and arboriculture, which the French have carried out with so great and so marked success in Algeria, in the Department of the Gironde and in the "Landes de Gascogne" (The brambles of Gascony). Is not the spirit and tendency of rural improvement to make artificial swamps, to saturate the sub-soil with moisture and vegetable débris, to produce plenty, and to develop disease? It is computed that

about one-third of all Hindoostan is composed of alluvium, more or less malarious. Looking at this vast area in a hygienic sense, with its teeming population, what a wide field is here presented to modify the severity and to reduce the mortality of disease. We spend large sums annually in Cinchona cultivation, but we are in a great measure heedless of the external causes which produce the diseases for which Cinchona is a remedy. Self-preservation demands that we stop an evil at its source, and though we may have a tolerably certain remedy to stay the deadly effects of malaria, yet the cure is very costly, and often not within the reach of the poor rural sufferer. It is to be feared that the following remarks of an intelligent observer of the famine now unhappily overshadowing a large portion of Bengal are but too true: "In the richest districts of the richest province of the Empire, pestilence has been doing a work during "the past ten years with a silent uninterrupted unappeasable "persistence, far more appalling to those who have watched the "facts than the most obtrusive range of famine;" in other words, famine kills its thousands, and pestilence its tens of thousands.

11. In Algeria, the Landes de Gascogne, and the Department of the Gironde, the superior efficiency of measures of prevention over those of cure has guided the French in their extensive scientific experiments, especially in arboriculture. So far back as the year 1695, the protective influence of belts of trees in the vicinity of the Pontine marshes was practically recognized. Indeed, to go farther back, the health-conserving property of trees was known to the ancients. That the peculiar attraction which marsh miasm has for the foliage of umbrageous trees should have been so long known and turned to so little account in this country must be a matter of surprise. For years we have had practical experience of the fact that trees afford a certain protection from, and a remedy against, marsh miasm, that dwellings within the immediate vicinity of marshes may be made, comparatively speaking, healthy by judicious tree planting,—nay we have practical demonstration of it in Demerara and other parts of British Guiana, perhaps the unhealthiest country in the Tropics. Yet what organized plan for carrying

this knowledge into salutary effect has been introduced? We have a highly organized Forest Department established on what basis?—the basis of hygiene, or the basis of profit? or of both combined, for they are very far from incompatible?

12. The result of French scientific arboriculture in Algeria has been embodied in a paper lately read by Mr. Gimbert before the French Academy of Science, conveying his unbounded faith in the marsh miasm-destroying powers of the *Eucalyptus Globulus*, which he attributes partly to the exhalation of camphorous vapours, and partly to its singular water-absorbing powers. The relation of cause to effect which co-exists beween certain conditions of the soil and the development of fevers and maladies of various natures can scarcely be considered matter of conjecture. Given moisture, an impervious subsoil at a depth of a few feet, vegetable and animal contamination, with favouring meteorological states, and all the conditions of disease development are fulfilled. It may therefore be logically inferred that the peculiar water-attracting powers of the *Eucolypti* in absorbing the surrounding impure surface-water and assimilating its animal and vegetable contaminations must be highly salutary. The health-conserving properties of trees yielding gum-resinous exudations as the *Coniferæ* has not escaped the observation of French sanitarians. The pestiferous climate of the "brambles of Gascony" has been completely changed by planting large forests of the *Maritime* pine, combined with surface drainage, and so paludal fever or the "mysterious Pollagre" has entirely disappeared throughout the vast plains of the Landes de Gascogne, so with the Department of the Gironde, and in a few years it is to be hoped the like happy climatic conditions will prevail throughout Algeria.

13. The remarkable fact that swamps in Australia, Tasmania, New Zealand, and New Caledonia do not produce paludal fevers was in itself a subject worthy of careful investigation. But here again French sanitarians in their extensive scientific experiments in Algeria with the *Eucalypti*, or the Giant Gum Trees of Australia and Tasmania, and with allied species of the *Genus Myrtaceæ*, have in a measure solved the problem. Nor has profit in these experiments been overlooked, large quantities

of sticks of a species of *Eucalyptus* have of late years been imported into England from Algeria for walking sticks, and in the Paris Exhibition of 1867 the leaves of the *Eucalyptus Globulus* were made into Cigars and recommended as an aid to digestion. The leaves of another species of *Eucalyptus* have been used on the Continent in place of lint for wounds, and have been found healing as well as antiseptic. But apart from the reputed febrifuge qualities of the *Eucalypti* and the remarkable water-absorbing capacity of the *Genus*, which is said to be so great as to be capable of drying up a pestilential swamp, and converting it into a dry and healthy district, the subject may be viewed in another light, and one which always commends itself to our notice. Looking at it in the light of commercial profit, the timber of the *Genus Myrtaceæ*, of which there are from 100 to 150 species, is most valuable. The Australian Colonists distinguish the *Eucalypti* by peculiarities of bark, some have smooth, other rough bark, some have fibrous (stringy bark), while others are solid (iron bark). The *Eucalyptus Globulous* (Blue Gum) *Eucalyptus Gigantea* (stringy bark,) and the *Eucalyptus Amygdalina* (Peppermint Tree), yield the most valuable timber, hard and durable, while the bark of some varieties which is shed from time to time is useful for firing, owing to the quantity of resinous matter it contains. The Cape Colonies where the *Eucalypti* have been introduced tell the same tale of the hygienic properties of the *Genus*, one species of which, the *Eucalytus Globulus*, is said to have exercised a marked beneficial effect on the climate of unhealthy districts. The *Eucalypti* yield valuable timber, are easily acclimatized, grow rapidly in almost any tropical or sub-tropical region,* possess highly valuable hygienic and medicinal properties—in a word, the *Genus* is alike calculated to improve the health and to add to the wealth of the country. Besides there is another and most important point in connection with the water-absorbing powers of *Eucalypti* on which I have not touched. I refer to the water-saturated soils of the plains of Bengal and elsewhere, the

* Dr. King, who is an authority on the subject, has only lately stated that the *Eucalyptus Globulus* will not thrive in Lower Bengal, and the Government of Bengal have accepted this verdict.—THE EDITOR.

yearly decreasing productive power of which has given rise to the erroneous argument that irrigation sterilizes, not fertilizes. The best system of extended drainage where the ground becomes water-logged and sterile has yet to be devised by engineering science. Might not the judicious planting of the *Eucalypti* solve the problem?

14. It is well known that the Delta of the Ganges is the birthplace and cradle of cholera, that the towns of Hurdwan and Jessore and other places in the Gangetic Delta have originated the disease, which passing westward has swept over Europe as a pestilence, penetrating even to America. Pettenkofer's ground and ground-water theory as regards the origin and spread of cholera is too well known to require remark. It has been violently attacked, and the controversy is still raging. But evidence connecting paroxysmal malarious fevers and other diseases with the soil is conclusive. The soil must play the principal rôle in the development of certain maladies. In any place where there exists at a depth of from 2 to 3 feet an impervious sub-soil contaminated by decomposing vegetable matter, intermittent fevers, &c., are there to be found: where it is contaminated by animal putrefaction, typhoid fever. Why then should Pettenkofer's ground and ground-water theory be so assailed when the genesis of cholera in the Gangetic Delta, its Head Quarters, is doubtless due to the soil and subsoil-water, saturated with vegetable and animal decomposing matter, which under favouring meteorological conditions develop the "cholera germ?" There are no effects without causes, and we must get at the cause if we would prevent the effect. It is our concern to find out how the pest of disease may be most surely, most effectually, most swiftly stamped out. Might we not try a little Munich hygiene, or the preventive principles of the French, and carry out extensive arboricultural experiments with the *Eucalypti* and other health-conserving trees in Hurdwan and Jessore, and other places unfortunately known as hot-beds of he disease, and if possible confer a boon on humanity?

15. Hygiene is a science which has claims to public recognition and to Governmental support on the grounds of the inestimable benefits it has conferred on mankind. Jenner in

his discovery of Vaccination; John Howard in his great Prison work and his final triumph over Jail fever; and Captain Cook in his successful prevention of Scurvy demonstrate how much hygiene has contributed to the happiness and improvement of man's condition, intellectual, physical, and moral. I would earnestly commend the subject to the consideration of the Government of India, in the hope that when the present feverish paroxysm of expenditure attendant on the famine so unhappily hovering over Bengal has subsided, it may not be succeeded by a cold fit of economy, where our common aim "the improvement of man's estate" is at stake.

16. Turning to climatic amelioration and its intimate connection with arboriculture, I fear there is too much truth in the assertion that the climate of some parts of India has of late years been more arid and injurious to both animal and vegetable life, on account of the increased demand for wood diminishing our forests in extent. Spain presents an example of a country where the climate has been seriously injured, and where the people in their infatuated dislike to trees have cut down whole forests—nay, they carry their dislike so far as not to plant any but fruit-bearing trees. We know the value of forest in a profitable sense, and we have only to realize the benefit of arboriculture as a safeguard to health, and an improver of climate, to stimulate activity in this direction. The British Army is in itself a proof of the general unhealthiness of the country. Notwithstanding all that has been done for the health and welfare of the British soldier in this country, we have not been able to change the climate of India. Indeed, I may say, we have never made any organized attempt to change it. It is true that many and various local causes of disease have been removed from every European station throughout the land, but the same physiological actions are in existence as formerly, which render India a dangerous country to the British soldier. As a rule we find that mortality and invaliding represent the opposite scales of a finely adjusted balance. Of late years mortality has considerably decreased, but invaliding has increased in almost exact proportion, and the result is that the total loss to the

Service is very little less than when our soldiers died in India, instead of being sent home invalided.

17. For climatic purposes we have to consider trees whose natural habitat lies in the vicinity of the sea-coast, and thoes suitable to the interior of the country, as also their commercial value. In respect to the former class of trees, the first in importance is the *Pinus Pinaster* (Cluster or Bordeaux Pine) one of the *Genus Coniferæ* which is indigenous to European countries bordering on the Mediterranean, and flourishes close to the sea. It has been found of vast importance in the Landes de Gascogne and the Departments of the Gironde in France, not only in a hygienic, but in an agricultural sense, for by means of large plantations formed of it, great tracts of land adjoining the sea-coast swept by ever-rolling sands have been reclaimed and turned to useful agricultural account. It has completely changed the pestiferous climate of those Departments, and is further valuable for the great quantity of turpentine it contains. For inland plantation we have a field as extensive in its range as the Australian Acclimatization Societies have made it, in laying under contribution, both in the animal and vegetable world almost every known country, not excepting that large and interesting Island Madagascar, about which we have known so little until recently, though it was discovered towards the close of the 13th century by the celebrated Venetian Traveller, Marco Polo. The Queensland Acclimatization Society has obtained and acclimatized the splendid Madagascar tree, *Poinciana Regia, Suborder Cæsalpineæ, Order Leguminosæ.* From the same country may be obtained the majestic *Rofia* palm, the leaflet of which splits into threads, and woven into cloth is used for many purposes. Likewise *Revenala Madagascariensis*, a magnificent palm-like plant constituting a genus of *Musaceæ*, called the "Traveller's Tree," because the leaves, when cut, and the stem, when pierced, yield an abundant and refreshing juice. The seeds are edible, and yield an essential oil. From Sumatra we might succeed in acclimatizing its most interesting and important tree, the *Dryobalanops Camphora* (or Camphor tree) of the Genus *Dipteraceæ* which grows to a height of 100 to 130

feet, and forms a trunk 7 to 8 feet in diameter. It is much prized by the Malays and Chinese, both for its camphor and wood. From British Guiana, that immense garden stored with an infinite variety of vegetable life, we might obtain the Chocolate tree, (*Theobroma Cacao*) the Cabbage tree palms, and many varieties of trees valuable for timber or ornamental furniture, and other purposes.*

18. I shall briefly refer to three vegetable products having useful, and to some extent hygienic properties which do not strictly come under the head of arboriculture. From Australia we might obtain the *Xanthorrhœa* (The Black-Boy or Grass-Gum trees of Australia), a most remarkable species of *Liliæcœ*, an order which affords many beautiful plants to the florist, one or two possessing medicinal virtues. The tall-growing species *Xanthorrhœa Arborea* and *X. Hastilis* form conspicuous features in some Australian landscapes, the leaves affording good fodder for cattle, and the white centre of the top of the stem food for man. In Madagascar a species of nettle yields a tenacious fibre, resembling hemp, which is spun into strong and durable cloth. At Sierra Leone a species of grass (*Bahama* grass), allowed to grow in the streets, is supposed to have improved the health of the place.

19. The question is one absolutely of hygiene, to be decided by scientific demonstration of the course most conducive to public health and prosperity, and I humbly trust that the facts and circumstances herein detailed may not be considered irrelevant; and that the importance of the subject, both morally, socially, and commercially, in which profit, health, and climate are so intimately connected, may commend itself to the favourable consideration of the Government of India. If on some points I have not spoken with "bated breath and whispering humbleness;" if I have drawn parallels to demonstrate our sad shortcomings in the science of hygiene, the end and aim, the motive and object in view, will, I hope, be held to plead my excuse.

* We have no desire to make any remarks on the above recommendations of those trees which are supposed to be *specially* qualified to counteract excessive moisture, but it appears to us, that out of the 2,000 species of trees which are found in Bengal and Assam, for instance, many might be found which would answer the purpose here aimed at as well or even better, than the exotic trees enumerated by Surgeon-Major Morton.—THE EDITOR.

The Eucalyptus Globulus.

From a botanical, economical and medical point of view; translated from the French of J. E. Planchon, Professeur à la Faculté de Montpellier.

By J. L. Laird.*

In those parterres which are one of the most recent attractions of Paris, at Monceaux the Luxembourg or in the Squares, the visitor may have remarked a strange shrub of peculiar form and color. It looks as if covered with a white powder, or rather with a glaucous bloom; four vertical rows of flexible branches, furnished with ovate, entire, opposite and sessile leaves, protrude horizontally all along its stiff straight stem. Reduced to the modest proportions of 16—20 feet, the *Eucalyptus globulus* is, indeed, nothing more than a novelty among innumerable other horticultural curiosities. It has been taken from a hot-house, and to a hot-house it will have to return before the beginning of winter; or, as is oftener the case, it will be pitilessly sacrificed to make way for younger trees, which, after being born in spring, pass the following winter under cover, are then planted out, completing the period of their *infancy* before the end of autumn. Thus, by the inclemency of the climate and man's caprice, the colossal dimensions of a giant of the vegetable kingdom are represented by a shrub, and its life confined to the short space of two years.

Even in Europe—wherever the orange flourishes—the rapidity of its growth is unequalled; but, to see gigantic trees, it is necessary to visit the Australian home of the Eucalyptus.

Wherever, in our hemisphere, winter is only a happy compromise between a prolonged summer and early spring, Australian plants, true to their natural mode of life, bud and grow from October to March; but the Eucalypti, more particularly when transported to Algeria, Corsica, or the mild climates of Provence and Nice—where they introduce a picturesque element in the scenery, and promise to become an important source of forest wealth—grow almost uninterruptedly and with marvel-

* This paper contains many parts, which might have been omitted in reprinting it in the I. F., but as that would have destroyed the connection between the different sections, the Editor considered it preferable to give the whole paper.—The Editor.

lous rapidity. The scent they emit is of recognized utility in hygiene, and has even been found useful in cases of intermittent fever. The Eucalyptus has further been useful in correcting the unhealthiness of marshes, and is, perhaps, the most important vegetable importation of our century.

Public attention has been directed to all these useful qualities, and we will endeavour, without losing sight of the practical side of the question, to give prominence to the scientific point of view, which, for several reasons, is of peculiar interest.

I.

The vast genus *Eucalyptus*, rich in more than 150 species, is typically Australian, that is to say, it bears the stamp of a country, the products of which are the most original in the world; a country where the swans are black, where mammals, such as the Ornithorhyncus and Echidna, are closely allied to the birds, and regarding the vegetation of which the late Abbé Correa de Serra exclaimed, "Flore au bal Masqué." And many plants seem, in reality, to bear a mask, so remarkable is their mimicry of other forms. Here, *Proteaceæ* assume the guise of ferns; there, legions of Acacias, far from displaying the pinnate foliage of the Mimosa, resemble the juniper or the willow. The Eucalypti do not escape this tendency to mimicry, and, strange to say, the same species is often different at different stages of its existence; these remarkable instances of heteromorphism are of frequent occurrence in Australia, and their philosophical bearing with reference to the theory of the origin of species is, perhaps, not yet thoroughly appreciated.

When young, *the Eucalyptus globulus* has, as we have seen, opposite, sessile and glaucous leaves, and somewhat resembles a myrtle or, perhaps, a frutescent St. John's Wort. But the shrub becomes a tree, and all is changed. New branches, no longer opposite but alternate, are thrown out; the new leaves, also alternate, have lost the ovate shape, and are lengthened and recurvate; their colour, too, has changed from glaucous to pale green, and, instead of being sessile, they are attached to the branches by slender petioles. The likeness to a myrtle has also disappeared, and the tree is now more like a willow. This

dimorphism, which is of frequent occurrence, gives a monotonous uniformity to the vegetation of Australia. Sparse pale foliage, often dazzling and of a dry, coriaceous texture, with drooping branches, is the well-known characteristic of Australian forests, which consist principally of Acaciæ and Eucalypti, and present a melancholy appearance whenever the flowers are wanting.

There are two well-defined periods in the life of the *Eucalyptus globulus*. During the period of *infancy*, when the leaves are opposite and sessile and the plant does not bear fruit, it is, so to say, in a *larva* state; the *adult*, or perfect state, being characterized by alternate and petioled leaves and the presence of flowers and fruit. We must, however, be careful not to continue the analogy too far, by comparing the dimorphism of the Eucalyptus with the metamorphoses of insects; with the changes, for instance, of a butterfly, which becomes successively a caterpillar, a chrysalis and a butterfly. In the latter case, the individual deprives itself of successive envelopes and becomes changed through internal processes and modification of the same organs; in the case of the Eucalyptus there is, properly speaking, no metamorphosis; all we can affirm is, that certain organs are superadded; in other words, the tree does not represent an individual, but an assemblage of foliaceous elements, of which each successive individual may have a peculiar form, different from either that of its predecessor or from that which follows. The similarities, or differences, between such elements do not affect their individuality; in short, there is polymorphism, but not metamorphosis in the strict sense of the word.

This polymorphism is not, however, a general characteristic of the genus. It is wanting in a certain measure in species, which, like the *E. cordata*, bear flowers on branches with opposite leaves. In such cases, the adult and infantile states are merged, and, without attaching much importance to the analogy between animals with centralized functions and plants with multiple elements, we may perhaps be permitted to compare the infantile and adult states of dimorphous Eucalypti with the tadpole and adult states of common batrachians (frogs, salamanders), while Eucalypti, which flower on infantile branches would be comparable with the so-called perennibranchiate batra-

chians—*Protei* for instance—which reproduce themselves sexually and yet preserve their branchial respiration.

But apart from this analogy, it is a remarkable fact that there are two kinds of flowering in some trees and only one in others. Now, supposing that, from some unknown cause, a Eucalyptus of the first group were to bear fruit on branches with opposite leaves, there is no reason to suppose that the seeds would not reproduce, in germinating, the characteristics of the plant from which they were derived, and that nature would not thus form a simple but permanent variety, the equivalent of what is every day described as a new species; in other terms, if the habitually sterile branches of an *E. globulus* were found bearing fruit, would not the plant constitute a new type, and, if met with alone and unconnected with its starting-point, be described as a new species? And who can say that many species, supposed to be genuine and accepted as such, are not derived from living or extinct types. This is, it is true, merely a hypothesis; but it is easily conceivable that the two forms which are seen in similar elements of the same plant, might, under favourable conditions, become permanently separated, and thus form new and distinct species.

I do not pretend to solve the complex problem of the origin of species; still, I find in the facts stated an argument *a priori* in favor of the theory of descent, as opposed to the theory of the absolute immutability of species; but let us descend from the somewhat misty regions of philosophic speculation to the field of facts concerning the *Eucalyptus globulus*.

Its discovery recalls to mind one of the great voyages of the old French navy. Nothing had been heard since 1788 of La Pérouse, and the National Assembly very properly resolved in 1791 to send a party in search of the unfortunate navigator. The command of the expedition was given to the Chevalier D'Entrecasteaux a sailor of the good old school and worthy follower of de Suffren. The two ships, the *Recherche* and the *Espérance*, carried a group of savans, amongst them the botanists Labillardière and Riche. The latter died of fatigue and grief at the loss of his collections, but the former brought back from Australia and Van Diemen's Land valuable materials,

which formed the basis of important publications. In his account of the voyage are to be found the details of the discovery of the Eucalyptus and the sagacious prediction that the tree would one day be used in ship-building. We will now quote from the naturalist's journal :—

"12*th May* 1792—The expedition was then in Port D'Entrecasteaux, Tempest Bay, Van Diemen's Land.

"I had been unable to procure a new Eucalyptus, which had remarkable fruit somewhat resembling a button. The species, which only bore fruit near the top, was one of the highest trees on record, several specimens being estimated at half a hectométre (164 feet) in height. The stem might be used in ship-building, perhaps for masts, although neither as elastic nor as light as pine. Perhaps it might answer for the latter purpose and be more pliable, if spliced, or even if split up the centre and the trunk strengthened by bands of iron. * * *

"We were at last obliged to fell one of the trees in order to procure the flowers; the felling was, however, quickly effected as the tree was much inclined. When falling, a quantity of sap spouted out of the lower part of the stem.

"This beautiful tree, which belongs to the Myrtle Family, has a rather smooth bark and gyrose branches, furnished at the extremity with alternate and slightly falcate leaves about 8″ by 2″ in size. The flowers are solitary and rise from the axils of the leaves. The bark, leaves, and fruit are aromatic and might serve, if necessary, as substitutes for the aromatics now imported exclusively from the Moluccas."

Labillardière also mentions that the wood of the *E. globulus* was used in repairing the launch; a modest beginning, but a prelude to its employment on a large scale in the construction of vessels.

For a long time the *Eucalyptus globulus* only excited the curiosity of a few botanists. It had even grown unnoticed in the Botanical Gardens, for, in 1854, I discovered a plant under the name of *E. glauca*, in the Conservatory of the Museum of Paris. Others were growing about the same time in M. Demidof's green-house at San-Donato under the name of *E. falcata*, and the horticulturists, Cels and Noisette, had cultivated some in

1822 and 1824, respectively, without knowing what they were. England, so rich in her collections of Australian plants, had paid no special attention to this tree as a garden plant, probably because when young its appearance is but little different from other well-known Eucalypti. The colonists of Tasmania, on the other hand, thoroughly appreciated their magnificent *blue gum*—as they called it—and employed it for various purposes; but, before this tree, confined to a remote corner of the world, was destined to form colonies far and wide, a chain of circumstances was necessary, of which the first link was forged scarcely forty years ago. These events were the foundation of the colony of Victoria; the building and marvellous development of a large city in a desert region, where the thirst for gold was to prepare the way for more real wealth, the result of the utilization of the pasture; further, the formation of a beautiful park in the hastily-built city of Melbourne, and, lastly, the exertions of two men, Von Müller and Ramel, who will always be remembered with gratitude wherever the Eucalyptus is a source of public wealth. In the history of the spread of the Eucalyptus, Von Müller is the man of science who carefully calculates the prospective value of the tree and predicts its destiny; Ramel is an enthusiastic amateur, who enters, heart and soul, into the work of propagandist. Both have faith; but the one is a prophet, the other an apostle. Hereafter, their respective rôles will be forgotten, and, as the army of Egypt spoke of Monge-Berthollet, so will the names of these two men be inseparably connected as Müller-Ramel in the minds of the people.

II.

One of the first things the English do after they have established themselves in a new country, is to make a public garden. What we have done at Bourbon, Pondicherry, Guadeloupe, Cayenne, Algiers, Saïgon, our neighbours have done on a large and magnificent scale at Calcutta, the Cape, Sydney, Ceylon, and on a minor scale at smaller stations where politics or commerce has given them a footing. Such gardens become, from the date of their foundation, fields of useful experiments on indigenous plants and exotics procured by exchange. Thus in

1832 complete collections of the vines of Luxemburg and the *Jardin des Plantes* were cultivated at Sydney. In this way the acclimatization of the vine was shown to be possible, and its cultivation soon spread in New South Wales, and still more rapidly in the more southern colonies of Victoria and South-Australia. In 1861, these two provinces alone had 1,000 hectares (2,469 acres) of vines, which already gave promise of becoming a new source of wealth. In the same way those centres of quinine-cultivation, Darjeeling, Ootacamund and Akgalle, are the offspring of the gardens of Calcutta, Madras and Peradenia. Thus the Peruvian barks, which are being gradually exterminated in Spanish America, are methodically exploited in the English and Dutch Colonies of India and Java, where the climate is even better adapted to their growth than that of the Andes.

Without insisting further on the advantages to be derived from colonial gardens, where botany assists and not unfrequently initiates—a fact too often forgotten—all kinds of culture, we may mention the Melbourne gardens as a case in point, there all vegetable productions of temperate regions have been experimented on, and there the most progress has been made in the study of the Australian Flora. Melbourne has also furnished all the botanical gardens of the world with seeds of living plants, some of purely scientific interest and others of economic importance.

It may not be inappropriate to say here a few words on the subject of acclimatization. The term seems to be used to express a change of country imposed by man on non-migratory plants. But the word, as it is generally conceived and as defined by dictionaries and etymology, implies an ignorance of nature and, if we may venture to use the term, of the constitution of plants. Animals, although the degree of resistance of some is very great, and although domestic species are in a certain measure protected by man in unsuitable climates, do not become acclimatized singly; selection alone, either natural or artificial, unconscious or premeditated, can effect a sorting of individuals of different constitutions so that those best adapted to the new conditions survive and the rest succumb; afterwards the law of heredity comes into play and gives to the survivors at least some of the resisting power

of their progenitors, which becomes fixed and gradually increased by reason of the natural tendency of the species in this direction. The final results of these gradual modifications, which are generally confined within very narrow limits, are better defined by the word naturalization then by acclimatization. The species, in becoming naturalized, is modified so as to adapt itself to the new environment. Individuals can only become inured by avoiding sudden transitions; man effects this object by clothing, by artificial heat and other means, which plants, fixed as they are to one spot and exposed to all kinds of weather, obviously cannot employ. Admitting, therefore, that man is acclimatized, and that through his care some animals adapt themselves to new conditions, we would prefer saying that plants are introduced or naturalized; but this adaptation, if real, is in any case slowly effected by the selection of successive generations resulting in the creation of new races, or local varieties more pliable in regard to climate and environment. An illusion, now past, led gardeners to believe that tropical plants would be able to live in temperate or still colder zones if, after being raised in green-houses, they appeared capable of withstanding sudden exposure. This was the case with the Mexican dahlias; but then two circumstances were forgotten:—

Firstly, that they grow in a comparatively temperate climate, considering that the slightest frost is just as injurious to them to-day as during the first year of their introduction. "Acclimatation, douce chimère des jardiniers!" says, Aubert Du Petit Thouars; and this verdict of an able botanist is the final condemnation of a specious, but equally false theory.

We are far from wishing to deprive those most useful societies of their title "Acclimatization Society," which they have inscribed on their colours; but it is well to forewarn the public of the error hidden behind an apparently innocent epithet. It was owing to an imaginary adaptation of this kind that a serious proposal was made to Government to grow tea and even cinchona in Algeria. It was thought that the problem to solve was merely one of temperature; whereas, as far as regards climate, much more important questions than either the absolute or mean tem-

perature, are the distribution of heat according to seasons and, more particularly, the balance between heat and atmospheric moisture. If we consider the latter question, we can then easily understand how it happens that Indian camelias, azalias and tea-plants are not injuriously affected by a moderate amount of winter-cold, and yet require during hot weather a moist atmosphere, the vapours of which protect the plants from direct solar heat. These conditions are more nearly reached in Western France, where there is a great deal of rain and fog in summer, than under the more southern sky of the Mediterranean sea-board and mountains of Algeria, where the summer is dry. It is not improbable that, if tea-cultivation on a large scale does not succeed at Brest and Cherbourg, its failure is partly, or entirely, owing to insufficient summer heat.

In order to naturalise a plant with any hope of success, it is necessary that the new climatic conditions should be somewhat similar to the old. To rely on a sudden change of climate would certainly be a mistake, unless, indeed, it was evident from modifications in the character of the vegetation that the climate was changing; to expect the nature of the plant to change would be still more absurd. The proper method to follow, both in theory and practice, is to consult nature, to study the climate, and to draw conclusions accordingly as to the probability of naturalizing such and such a plant; then experiments should be made with a view to finding out the conditions best suited to the species in its new home. Such complex problems cannot be solved *a priori*; a number of facts must be first of all collected, and it is easy to overlook one, which may be sufficient to cause the failure of the most promising undertaking.

At first sight, it would appear probable that if plants of one region are easily naturalized in another, the converse would also hold good, and plants of the latter region be easily naturalized in the country of the former. There is no greater mistake, and botanists know the reason well. Wild and cultivated plants of Great Britain have been introduced in great numbers into Australia, and most have already become noxious weeds, but not one single Australian plant has yet propagated itself in England,

excepting in ornamental gardens, where Australian plants have been cultivated by thousands. The English winter is assuredly not the only obstacle to the naturalization of Australian plants; it would spare, at least, annuals and those which reproduce themselves yearly by seed, and the obstacle should be sought for in internal conditions, such as the requirements and mode of life of each plant, rather than in purely climatic conditions. Some types are essentially migratory, spreading wherever the climate does not impose a veto on them; the characteristic of others is essentially sedentary. The former are aggressive, and even noxious to the indigenous vegetation; the latter, confined to a relatively small area, are exposed to, and unable to defend themselves against the attacks of man and imported animals (goats, rabbits, etc.), and are even subjected to a fatal competition with strange plants. This is the reason why, in our day, some species of the Mallow Family of St. Helena, peculiar to the island, are gradually disappearing under the combined actions of man, sheep and Australian Acacias.

But, to return to our subject, M. de Candolle distinguishes several kinds of naturalization. In an absolute sense, a plant is not naturalized until it can maintain itself alone in its adopted country, pass successfully several years of extremes as regards climate, reproduce itself by seed, and, in short, compete unassisted with indigenous species. Every plant which, after being repeatedly introduced into a country, fails to maintain itself is simply *adventive*. Others, which only reproduce themselves from stools, as is the case with the sumac-tree of Japan, are only half naturalized, or, more properly speaking, the individuals are naturalized but the species are not, for, continued and spontaneous reproduction by seed is the criterion of naturalization. Comprised in these two categories are two others: that of plants which follow in the footsteps of man and domestic animals, never leaving their dwellings or their fields (harvest plants), these are, in reality, strangers which have been admitted as a privilege to a corner of the domestic hearth, but to whom an independent life is denied; then there are cultivated plants properly so called, either

domesticated or wild, which cannot maintain themselves in a foreign country unless carefully protected by man.

The Eucalyptus belongs at present to the latter category, as far as concerns its naturalization in the extreme south of Europe and Northern Africa, where the tree has been introduced and extensively cultivated but, although well suited to the climate, not yet naturalized. De Candolle's distinctions are, however, of little consequence, if the practical result remains the same, and there is no reason why this beautiful tree should not some day reproduce itself spontaneously. In the meantime, as we cannot follow it in its voyage round the world, we will endeavour only to trace the history of its recent introduction into Provence, the Maritime Alps, and more particularly Algeria.

The principal supporters of the Eucalyptus are Baron v. Müller and Mr. Ramel, the former naturalized Anglo-Australian, but a German by birth, is a naturalist and traveller, and has especially distinguished himself by his botanical researches in Australia. He has been for more than twenty years Curator of the Botanical Gardens at Melbourne, which he has constituted one of the largest depôts in the world for the exchange of plants. He is a clever writer and indefatigable collector, and has described all the economical resources of Australia, both in indigenous and exotic plants, and has further done his best to enrich other lands with the natural productions of his adopted country. In this generous endeavour, he has been ably seconded by our countryman, Mr. Ramel. Of an ardent disposition, and imbued with unswerving faith in the future he has pictured, M. Ramel has become, almost by chance, a patron of the Eucalyptus. In 1854, having gone to Australia on business, he was one day walking in the Botanical Gardens at Melbourne, when his attention was attracted by the elegance and beauty of a blue gum (*E. globulus*) growing in a sidewalk. Being almost a stranger to botany, he neither knew the popular nor the scientific name of the plant; but from that moment the tree became a fixed idea in his mind, and was the means of bringing him into contact with v. Müller and other savans and amateurs. He believed in the Eucalyptus as some believe in the

triumph of good on earth, and had the satisfaction to see it covering the mountains of Algeria, restoring the salubrity of marshlands, driving away fever, and substituting sweet-scented cigarettes in place of the stupifying fumes of the *heshich*. The dream of yesterday has been all but realized to-day; for, cigarettes apart, no forest tree has hitherto introduced so picturesque and useful a feature in the scenery of Algeria.

The *Eucalyptus globulus* had been exported to Algiers in 1854 but without any one knowing the fact. In 1863, when visiting the experimental gardens on the slopes of the Saleb, I picked up some seeds of a tolerably large tree which I at once recognized as the *globulus*. This tree had probably been raised in 1854 from the same consignment of seeds as the one I had previously seen in a hot-house of the Paris Museum under the name of *E. glauca*. While this *adult Eucalyptus globulus* flourished unknown on the hill-side, thousands of the same species were to be seen under their proper name in the nurseries of the *Hamma* (an experimental garden). The seed sent from Melbourne by Baron v. Müller and others had been sown in 1861. It was M. Hardy's intention to have distributed the young seedlings throughout the colony; but, before the distribution was effected, a fortunate colonist, M. A. Cordier, applied to M. Ramel and procured a hundred seeds from him in 1862. From these he raised 62 seedlings, which were only 15 centimètres high in May 1863. In the spring of the same year I sent to Mr. Charles Bourlier 12 plants, given to me by a nursery-gardener of Montpellier, and these, too, flourished and grew rapidly. In the same year thousands of the young Eucalypti at the Hamma were distributed all over the country. In the race, M. Cordier maintained the lead, and planted several hectares with the new species.

Soon afterwards, another colonist, M. Trottier, was in his turn seized with Eucalyptus-fever. He, too, had faith in the tree and proved it by planting energetically for others, as well as on his own account. He foresaw its industrial importance in the future, and did not hesitate to take for his motto "The wood of the Eucalyptus will one day be the principal product of Algeria." He went even further, and in his "Boisement

dans le désert et Colonisation," drew a picture of the forest invading the desert, drawing up the subterranean water, and entirely altering the climate of the country. It must be admitted that there is something Utopian in the language of the author, but enthusiasm is worth something when it is necessary to attract public attention to a useful object, and even though the pioneer of a new route is sure to make mistakes, such mistakes serve to guide the prudent and the timid.

However, although the desert is not yet reclaimed, the cause of the Eucalyptus is now fully established in other respects. It has been naturalized on a grand scale, and hundreds of thousands of trees have been planted out, singly or as forest, all over the country, so that a stranger who did not know its history would take it for an indigenous plant.

It is, by the way, a curious fact that two plants, to all appearances the most characteristic of Algeria, have been imported since the discovery of the New World. The Indian fig-tree and the American aloe are not only strangers to Africa, but are representatives of two exclusively American families, and if there were no documents to prove their importation, botanists alone would be able to infer the fact from the natural geographical distribution of the families and from the circumstance that they are generally reproduced either from slips or suckers, instead of from seed.

Although the Eucalyptus, like the American aloe and the prickly pear, seem as if created expressly for Algeria, it does not find as suitable a home everywhere on the Mediterranean Coast. In the south of France, spots suitable to the growth of Australian plants are only to be found where the orange flourishes in the open air. Port-Vendres, Callioure in the Eastern Pyrenees, Saint-Mandrier, Hyères in the Var, Cannes, the gulf of Zouan, Antibes, Nice, Villefranche, Monaco in the Maritime Alps are favoured stations, where winter is the flowering-season of thousands of exotic plants. Beyond this zone, the climate of the Olive is too variable to suit the constitution of the Eucalyptus. The clearness of the sky in these parts favours radiation, and sometimes gives rise to frost which destroys in one night the hopes of a whole year; not to mention

the occurrence at long intervals of very low temperatures (down to 17° C. at Montpellier) which kill even indigenous trees (laurel, laurustin, rock-rose, kermes-oak). At Montpellier and Marseilles, and even at Narbonne, experience teaches that the cultivation of Australian plants is extremely precarious. From 1863 to 1870, I experimented with the *E. globulus*, and finally came to the conclusion that its cultivation in the open air in Languedoc, or even Western Provence, can at best only be a partial success and, as far as regards the reboisement and drainage of marshes, can never have any practical results. In Camargue no experiments have been made, but it is more than doubtful that the cultivation of Eucalyptus would succeed in a level, unsheltered part of the country, exposed to the full force of the mistral, and with a vegetation which does not indicate a warmer climate than that of Montpellier. Even on the hill, named *Roucas Blanc*, at Marseilles, where M. Talabot has skilfully protected it under nurses of Aleppo pines and behind rocks, the Eucalyptus is evidently delicate, and although rapid in its growth when young, does not give much hope for the future; moreover, it is liable to be killed by the first exceptional winter.

The Eucalyptus was introduced into Eastern Provence about the year 1854. Since the year 1860 the brothers Hüber have had a typical plant in their garden at Hyères, that is to say, one with a pyramidal crown. The same year M. Gustave Thuret, of Antibes, planted out one in the open, and in 1860 it had successfully withstood the cold of two winters. Some seeds, received from Baron v. Müller in 1860, and sent by me to M. Thuret, were sown in the spring of 1861; in January 1862, the young plants, after a very dry year were 2 to 3·25 mètres ($6\frac{1}{2}$—$10\frac{1}{2}$ feet) in height. On seeing these plants in November 1868, I could scarcely believe the testimony of my eyes; the seedlings had grown into trees with respectable trunks and an ample crown of flowers. Now-a-days, the traveller from Monaco to Cannes can see during the whole of the journey the erect branches and tremulous leaves of the Eucalyptus contrasting with the pale foliage and venerable trunks of the olive, or with the umbrella-like crowns of the Italian pine.

So far then, we have seen the Eucalyptus established, or at all events naturalized in Algeria and the winter-stations of Nice and Provence. What advantages may we expect to derive from the tree? Many—some evident, others, perhaps, less so, but in favour of which the indirect evidence is so strong that we may safely take them into account without fear of being considered rash. In the sketch we are about to give of the approved and possible uses of the new tree, two points of view present themselves. On the one hand we have the Eucalyptus as a forest tree, on the other its use in restoring the salubrity of marshes, in curing fevers and other maladies, and as an aromatic, not only in medicine but also in perfumery and confectionery.

III.

Many species of Eucalyptus become veritable giants in their own country. "A *Eucalyptus colossea*, called *karri* by the natives, was found to measure," says Baron Müller, "122 mètres (400 feet) and some specimens of *Eucalyptus amygdalina* 128 mètres (420 feet) and even 145 mètres (475 feet). The height of another, not measured, was estimated at 500 feet (152 mètres.) For the sake of comparison we may take the dome of the Invalides 105 mètres high, the spire of Strassburg Cathedral 142 mètres, or the pyramid of Cheops, the highest building in the world, 146 mètres. The *Eucalyptus amygdalina* would, therefore, overshadow the Great Pyramid. The highest Wellingtonias in the district of Calaveras in the Sierra Nevada, only measured 76—98 mètres (249—321 feet). The trunk of the largest measured 8·86 mètres (28·06 feet) in diameter, whereas a Eucalyptus in Tasmania measured near the ground 9·15 mètres (29 feet) in diameter, and 3·66 mètres (12) feet at the intersection of the first branch, which was at a height of 70 mètres (229 feet), the total height of the tree being 91·5 mètres (300 feet). An approximate calculation gives the weight of this tree as 4,46,886 kilogrammes (9,83,150lbs.)*

*According to v. Müller (*Report on the Resources of Victoria*, 1860,) the dimensions of a tree in a valley near Wellington, Tasmania, were: Circumference near the base 29·25 mètres (95·94 feet), at a height of 2·6 mètres (8·5 feet); the circumference was 20·2 mètres (66·25 feet), at 6·8 mètres (22·28 feet), 8·2 mètres (26·9 feet) the approximate height of the tree being 98 mètres (315 feet). Judging from previous measurements the tree must have been 800 years old.

Although it does not attain to such huge proportions, the *E. globulus* is one of the largest forest trees of Australia and of the world. Immense planks have sometimes been on view at International Exhibitions, and one was sent in 1862 to the Exhibition in London, which measured 23 mètres (75 feet) in length and 3·5 mètres (11·48 feet) in width. A plank 51 mètres (167 feet) long was to have been sent, but no ship could be found large enough to carry so cumbersome a burden; the only way would have been to have made the plank form part of the structure of the ship, a purpose to which the wood is now being applied in England, but more particularly in Australia, where its solidity, durability, and tenacity are thoroughly appreciated. "The best South-sea Whalers," writes M. Ramell, "are those of Hobart Town, a place celebrated for its unrivalled keels, which are made of *Eucalyptus globulus*."

The wood of the Eucalyptus combines the qualities, rarely found together, of density and rapidity of growth. The latter is more remarkable during the first few years, but the tree still continues to grow rapidly in height until its 80th year; after this age, the stem, generally very straight, only grows in thickness. Its compact and tough wood resists decay for a long time, even when in contact with salt water, a fact probably owing to the presence of a resinous substance. Like the oak, it lasts a long time in the ground, and is used for railway-sleepers. Its durability makes it much sought after for bridges, piers, viaducts and the bottoms of ships; for piles it is only surpassed by the white oak of Canada, and the only reason why it is not much used in house-carpentry is, that it is too difficult to work and cut up into small pieces. In 1860 the price of a cubic foot at Melbourne varied from 2·5 francs to 3·75 francs (2*s.* 1*d.*—3*s.* 1½*d.*) according to the size of the log.

It is not easy to estimate the prospective value of forests of blue gums raised in Algeria, and an approximation to the truth is all that can be expected, since the calculation is necessarily based on imperfect data. M. Trottier, who is evidently over-sanguine, anticipates for a hectare (2·47 acres) containing 500 blue gums, a nett revenue of 1,200 francs (£48) after 5

years, and of 53,254 francs (£2,130) in 26 years. He gives the prospective yields as follows:—

A hectare cleared in the	5th	year	produces	nett	1,200	Fr.
Ditto ditto	10th	„	„		5,254	„
Ditto ditto	15th	„	„		11,708	„
Ditto ditto	20th	„	„		25,366	„
Ditto ditto	25th	„	„		53,254	„

In a paper read before the Agricultural Society of Algiers in March 1868 M. Trottier gave his reasons for these figures as follows: A hectare can bear 500 trees. If the plantation succeeds, all these will have a diameter of 20 centimètres (7·9 inches) at 2 mètres (6½ feet) above the ground by the end of three years. Trees of this size could be sold at the rate of 5 francs per mètre, and the first thinning would yield 2,500 francs. At eight years the remaining trees would be of a size suitable for railway-sleepers and each tree would be worth 20 francs; a hectare would thus have yielded a gross revenue of 6,200 francs. One thing, however, I cannot understand, and that is, how M. Trottier manages to cut, from a total of 500 blue gums to the hectare, a sufficient number after three years to realize 2,500 francs, and yet leave a sufficient number of trees to make 3,700 francs by their sale five years afterwards. In order to do this, it would be necessary to leave 185 standards after the thinning.

Mons. Gumbert's method of valuation is quite different. He takes the value of all the *seed-woods* (*i.e.*, forests always reproduced by seed) of France 4, 137, 995, 228, francs, as a basis. The state cuts seed-woods every 100, 150, or 200 years, the communes every 100, and private individuals, on an average, every 70 years. Assuming that all seed-woods are cut on an average every 100 years, the Eucalyptus would be cut five times during the same period, and the value of the forests would be five-fold. But it is clear that this calculation is only applicable to a very small portion of France, as the blue gum only thrives on an area limited to certain localities of the Mediterranean Sea-board. M. Regulus Carlotti estimates that if a large area in Corsica was planted with blue

gums, there would be a clear profit of 1,295,000 francs in 8 years.

Mons. Lambart, of Algiers, a retired Inspector of Forests, published a book in 1873, in which he gives the value of a hectare of blue gums subject to a revolution of 10 years, as 34,121 francs. "If the regeneration were effected by sowing, the expenses would be 666 for a hectare; if by planting 2,131 francs." His supposed returns are therefore much higher than those calculated by M. Trottier. I give the figures, acknowledging my inability to discuss them.

It is well to compare these statements with the following much more modest calculation of M. Cordier. He supposes, if a thousand trees are planted out as forest and regularly thinned that, after 5 years 500, value 600 francs, could be cut, in the 10th year 250, value 1,313 francs, in the 15th year 125, value 1,473 francs, in the 20th year 60, value 1,521 francs, in the 25th year 60, value 3,195 francs, giving a total of 8,102 francs, and representing for a revolution of 25 years an annual income of about 300 francs. Although this result does not nearly come up to the expectations of certain planters, it represents a very good profit, and ought to be sufficient encouragement to the colonists to continue planting.

M. Trottier, when estimating the annual growth of the Eucalyptus, based his calculations on the increase of trees at the Hamma, whose mean yearly growth was about 13 centimètres (5 inches) in circumference; but as these trees were planted in line, M. Trotlier thinks a fair rate for trees planted in the forest would be 10 centimètres (3·9 inches), but he forgets that 500 trees could not be maintained for 26 years on a hectare without their injuring each other, and that for this reason periodical thinnings would be necessary. M. Cordier has taken into account the deficit occasioned by such thinnings, hence the difference in the results obtained, in spite of his employing in his calculations the same rate of growth and the same prices as formed the basis of Trottier's estimate. It is not for me to decide who is right; this question must be determined by the practical forester. It can, however, only be solved by an appeal to facts, and much must always depend on

the station in which experiments are made, for results obtained in one particular place are not necessarily true for another.*

Another question to be solved practically is, what stations are best suited to the growth of the trees. As regards soils and with reference to its hygienic utility and rapidity of growth, hot and swampy lowlands seem best suited to the Eucalyptus; but as, according to v. Müller, it is satisfied with poor, dry soils in its own country, the blue gum may perhaps be found useful in reboising the denuded hills of Algeria. It is, however, well not to be too sanguine: out of nothing comes nothing, and plants, even those with the constitution of a camel, cannot withstand the aridity of the desert, unless endowed with the power of drawing up water from considerable depths: as far as we are able to judge, the Eucalyptus seems to be able to resist great draught in summer, but also to derive much benefit from the rains of autumn, winter and spring, wherever the climate admits of uninterrupted vegetation during these seasons.

The almost fabulous rapidity of growth of the Eucalyptus is explained by the admirable continuity in its vegetation. As soon as the roots establish themselves in a fresh and fertile soil, such as is found at the *Hamma*, the mean monthly growth in length sometimes amounts to ·5 of a mètre (1·64 feet). [Hardy]. At Cannes plants one year old, planted out in May, had reached a height of about 6 mètres (20 feet) in the following December; after the third year the rate diminishes; still, it continues sufficiently rapid to allow a tree planted in 1857, as, for instance, that of the Brother Huber at Hyères to attain a height of 25 mètres (82 feet) in 1872.†

IV.

In Valencia the popular name of the Eucalyptus is *fever-tree*, a synonym which proves the general belief in its efficacy as

* I fear that all these calculations are considerably above the returns which can reasonably be expected, if the tree is cultivated on a large scale. As M. Blanchon remarks, only actual facts can decide this point.—THE EDITOR.

† M. Ramel writes to me from Hussein Dey near Algiers, on the 4th May, 1874: "I planted during March and April, nearly 14,000 blue gums. They were planted at 1 mètre (3·28 feet), 1·5 mètres (4·9 feet) and 2·5 mètres (8·2 feet) apart. They are getting on splendidly. I measured one which is 4·2 mètres (13·78 feet) high, with a spread of 3·75 mètres (12·3 feet) and a stem ·25 of a mètre (9·84 inches) in circumference. This particular tree was raised in January from seed and planted out on the 25th March.

an antidote against miasmatic fever. There are two ways of combating endemic diseases of this kind. Firstly, by improved sanitary arrangements calculated to stamp out the evil altogether, and, secondly, by medical treatment. Let us examine the use of the Eucalyptus from both points of view.

It is a well-known fact that countries which abound in primeval forests of blue gums are generally very healthy. Their salubrity might, however, be attributed to the influence of climate; but M. Ramel, giving way, perhaps unconsciously, to a feeling of partiality for his favourite tree, at once attributed this healthiness to the action of the Eucalyptus, an idea which took firm root in his mind. Although the assumption was scarcely justifiable at that time, it was soon strengthened, and finally incontrovertibly proved by the effect of Eucalyptus plantations on the healthiness of marshes in different parts of the world. The first known case of its influence in this respect was at the Cape of Good Hope, where the blue gum is said to have restored the healthiness of certain parts of the country; later on experiments were made in the Spanish provinces of Cadiz, Seville, Cordova, Valencia and Barcelona, where the blue gum was introduced in 1860 by the Acclimatization-Society; further proof is furnished by the reclamation of unhealthy swamps in parts of Corsica and Algeria. The evidence regarding the influence of the Eucalyptus is all the more reliable as having come from able physicians, more particularly Dr. Carlotti.

The healthy action of forests of Eucalyptus may be explained by a combination of two causes: the influence they exercise by absorbing moisture and exhaling it from the leaves, and that caused by volatile substances given off by the aerial parts of the tree. These emanations, of which the basis is an essential oil, act, perhaps, on the constitution as a stimulant, in the same way as the scent emitted by pines is known to benefit the health or even to cure certain diseases of the lungs, and to act as a tonic in cases of debility. M. Gubler thinks that these volatile substances may even neutralize or destroy the unknown germs which seem to be the cause of miasmatic fevers, and which consist, according to some authors, of microscopic *Algae*, and, according to others, of Animalculæ. Practically it does

not matter how this question is settled, as, the hygienic utility of the Eucalyptus is fully established, and for this reason the tree should be planted wherever miasma is prevalent.

But this is not all. Without being an antiperiodic after the manner of quinine, the Eucalyptus is, according to authentic accounts, a most efficacious remedy in many kinds of intermittent fever. Since 1863 M. Ramel, although unacquainted with medical science, has persistently maintained the medicinal value of the tree and its influence on the climate of Southern Australia. When visiting the Eucalyptus-plantations at Valencia in 1863, he remarked, pointing to the pestilential swamps, to Mr. E. Wilson, "That is the hot-bed of the fever which desolates the country, and that is *the* place for the Eucalyptus which is destined to stamp out miasma." Two years later M. Robillard, a well-known horticulturist, now settled in Spain, when visiting the Museum at Paris, was shewn the *E. globulus* as a novelty. "A novelty," he exclaimed, "that may be the case here in Paris, but not in Valencia; there it is already the popular remedy for fever, and so well known that the leaves are stolen at every opportunity; in fact, in the public gardens of a certain large town it became necessary to put a guard over the trees."

The first experiments on the febrifugal virtues of the blue gum were made in Spain by Dr. Tristang, and the results published in a work but little known, *El Compilador Medico*; the experiments were favourably noticed in Medical Journals, and confirmed the good reputation already gained by the new remedy in the Spanish provinces bordering the Mediterranean. A doctor living at Monte Video, Adolphe Brunel, was in consequence engaged to make experiments with the Eucalyptus. Unfortunately he died suddenly in 1871, but his manuscripts were published by his family. In the meantime, the researches of Gimbert at Cannes, Carlotti and Tedeschi in Corsica, T. Marès and Miergues in Algeria, Gubler and Lenglet at Paris, Lorinser at Vienna, G. Sacchers in Sicily, Caston at Montpellier, and many others placed the febrifugal properties of the blue gum beyond doubt.

Besides those already mentioned, we must not forget the disinfecting and antiseptic virtues of the Eucalyptus. The

tannin of its leaves acts as an astringent tonic, and its essential oil as a stimulant. The leaves, if applied to wounds, promote the process of healing, and when infused, weak doses act as a healthy stimulant in place of tea. Properly understood, the Eucalyptus is useful in certain diseases of the lungs, and M. Ramel recommends, with a confidence which we would like to see justified, the use of Eucalyptus-cigarettes, which are said to have afforded relief to Trosper Mérimée in his last illness when suffering from asthma.

The chemical uses of the blue gum can only be lightly touched upon in a sketch from which all technical details are excluded; all these may be found in the works of Messrs. Taillotte and Höckel, who also give the chemistry of the different substances extracted from the tree. The most interesting of these is the *Eucalyptal*, a volatile product extracted in 1870 by M. Cloëz, Analyst to the Museum of Paris, from the essential oil of the Eucalyptus, and which he further resolved into two new bodies, *Eucalypton* and *Eucalyptolin*; these substances are, however, of purely chemical interest. The action of the oil—which is easily obtained by distilling the leaves and other parts of the plant—both on healthy and on unhealthy constitutions was carefully studied by Dr. Gimbert. Large doses are poisonous, but smaller ones act as sedatives, and seem to affect the spinal cord, and through it the lungs, circulation and temperature of the body. The presence of an oil similar—at all events as far as regards one of its components, Eucalyptol—to peppermint and the camphor of Java and Borneo, at once explains some of the properties of the Eucalyptus (such as its stimulative and antiseptic action, and its effects on the mucous membrane, circulation, bile, etc.) The tonic and astringent action of the tree is explained by the presence of tannin; but, in order to account for its action in cases of fever, a special substance, supposed to be an alkaloid, was naturally sought for, and M. Carlotti even thinks that he has succeeded in discovering this base in a resinous substance similar to that found in cinchona. In the subsequent researches of Messrs. Borde, Tailotte and other chemists, this product was not discovered, and its existence is, therefore, still doubtful.

Essence of Eucalyptus has already been used for the toilette as an aromatic vinegar. Like all strongly smelling, volatile oils, it is too pungent to be pleasant when pure, but on being diluted the aroma is softened and of a kind quite peculiar to itself, but which, according to some, resembles that of camphor, laurel and peppermint. M. Ramel has had bon-bons made of it, which are recommended in cases of cough and bronchitis.

The *Eucalyptus globulus* is not the only tree of the genus which has volatile oils; all the Myrtle family have organs filled with similar substances, and the popular names of the Eucalypti are derived from their characteristic perfumes. Thus the largest, the *E. amygdalina*, is called *Tasmanian Peppermint* or simply *peppermint*. Experiments are now being made to determine the value of these essences as solvents of resinous substances and even as burning-oils.*

Resins are also common to nearly all the species of Eucalyptus, and the name *gum tree*, or more specially red, white, blue, etc., gum, refers to this product; other popular names, such as *stringy-bark* (*E. obliqua*, L'Heritier, the first described species), *iron-bark*, refer to other characteristics.

But it is time to conclude this sketch originally intended only to have reference to the blue gum of Tasmania, which, in spite of its numerous congeners is the only Eucalyptus that has established a firm footing in those parts of Europe, Asia, Africa, and America, where the climate is compatible with its cultivation. It is, moreover, a rare example of an Australian tree, which has become a citizen of the world by right of its beauty and usefulness.

For ages scarcely able to support a few miserable inhabitants, a wilderness destitute of fruit trees and with but a scanty Fauna, Australia has, in less than a century, become peopled with the cereals, fruits and domestic animals of Europe. Already she sends us, besides gold and richly-flowering plants, wool and the flesh of sheep and oxen, the produce of her immense pastures. Already her flora gives promise of transforming the character of the vegetation of Algeria and the region of the orange; while above

* See in regard to this subject Baron v. Müller's *Indigenous vegetable substances* at the *Victorian Exhibition*, Melbourne, 1862.

the legions of strange types, there towers the commanding form of the Eucalyptus, king of the brilliant cortége.*

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* The following extract, taken from the *Popular Science Review* of the 1st April 1875, is interesting:—

"*Tincture of Eucalyptus globulus in Intermittent Fever.*—The following results are summed up, by Dr. Hirsch (*Berliner Klin, Wochenschrift, No.* 30) as obtained from his experiments with the tincture in nine cases of obstinate intermittent fever: (1.) In all cases, after the use of the remedy for one or more days, the spleen diminished in size. (2.) In six cases, three, at most four, tea-spoonfuls of the medicine were sufficient to prevent a return of the paroxysms. In one case only was the double quantity required. (3.) Seven of the nine cases were cured completely; in the remaining two the remedy proved unsuccessful. From these results Dr. H. draws the conclusion, that tinct. Eucalypt. glob. is a remedy but little, if any, inferior to quinine in the treatment of intermittent fever, and that it will probably prove to be as valuable an antiphlogistic in the treatment of other fevers as quinine, digitalis, and veratrum."—J. L. L.

Forest Flora of North-West and Central India,

Commenced by the late J. Lindsay Stewart, M.D., *Conservator of Forests, Punjab, continued and completed by Dietrich Brandis, Ph. D., Inspector-General of Forests to the Government of India. London: Allen,* 1874.

BY GEORGE KING, M.D.

AMONG the large number of trees indigenous to India it is wonderful how few are considered by the natives of the country as valuable on account of their timber. This is due to various causes, partly to a lazy wasteful disposition to reject all but the very best, partly to the total absence among the natives of any method for the preservation of cut timber, often to the want of proper tools for conversion, but also very greatly to ignorance of the properties of the various indigenous timbers. A timber-dealer in the plains of the North-West Provinces still classifies all trees in two divisions. To the one he admits only sal, sein, sissoo, and possibly koosum and sandan. To the other he contemptuously relegates all other trees indigenous in the province, and as a rule he is unable to distinguish these from each other by name, either in the forest or in the timber-yard.

When the attention of Government began first to be given to the preservation of the forests of the country the contents of these forests were nearly as little known as their boundaries. The latter are being gradually settled, but a thorough knowledge of the former is more slowly arrived at, involving as it does the education of a special class of officials trained to observe and to appreciate and recognise specific differences among trees as they grow, as well as to guide and direct the utilization of forest produce of all kinds. No true progress could be made in the direction just indicated until the knowledge of the Indian trees, already existing scattered in the works of writers on Indian Botany and in the brains of living students, had been reduced and arranged in a compact consultable manual, and such

a manual naturally suggested itself in a scientific form, in other words, in the form of a *Flora sylvatica* or systematic description of the constituents of the forests of the country. As a matter of convenience, the *Flora sylvatica* of India has been divided into sections. That for the Peninsula prepared by Major Beddome has been for some time before the world. The section for North-West and Central India is now under review; a third for Burmah is in preparation, and others may possibly follow.

A profound knowledge of Botany is not necessary to a forest officer, for Forestry is an art and forms no integral part of botanical science. But like other arts it is, even if empiric in origin and practice, not only capable of being supplied with a scientifi cbasis, but is vastly strengthened by such a basis. The possession of a certain amount of botanical knowledge, and above all of the habits of observation which the practical study of botany engenders, are of the greatest use to the forester. The learned and scholarly book, of which the title stands at the head of this article, puts into the hands of the forester in Upper India a fund of information about the trees and useful plants of his province, to avail himself of which to the fullest extent will require very little botanical training on his part. In fact the careful study of any elementary manual, such as Oliver's First Book of Indian Botany and the dissection of a few flowers and seed vessels, will form a sufficient preliminary equipment.

Originally begun by the late Dr. Lindsay Stewart, this Forest Flora for Upper and Central India was continued and completed, as it now stands, by the present Inspector-General of Forests, Dr. D. Brandis. The work was written in the Herbarium at Kew, where unquestionably exist the best materials for any work on Indian systematic Botany. Dr. Stewart was an indefatigable note-taker and, during his innumerable tours in Upper India, he amassed a large amount of information on the local uses of plants of every kind, herbaceous and woody. He also collected with painful diligence an immense number of vernacular names. Part of this information was published six years ago in Dr. Stewart's book on Panjab plants, which volume, as well as his unpublished notes, have been largely utilised in the present work. Dr. Brandis has himself tra-

velled extensively over the same ground as Dr Stewart, and although the preparation of a *Flora sylvatica* formed no part of his plan during these journeys, he made an extensive series of notes which have also been taken advantage of. Neither he nor Dr. Stewart having however sufficiently explored the forests of Oudh and Central India, a special officer, (Mr. Richard Thompson) was deputed to collect in these provinces. This book has therefore had every advantage in the way of material and of field notes, and it must be said these materials have been most excellently used.

The natural and political divisions of a country do not, unfortunately as a rule, coincide. The scientific forester regards the former as of more value and significance than the latter, and these Dr. Brandis inclines to follow as far as possible in limiting the area dealt with in his flora. He therefore includes the arid tract occupied by the independent native states of Rajpootana, which lies between the Panjab, North-West and Central Provinces, and of which the flora has from its scantiness and desert type a peculiar interest. Northwards his limit is the treeless region of the inner Himalaya from the southern bend of the Indus to the river Kosi; southwards it is the Maikal and Satpura range of hills; the western limit is the Panjab Frontier along the foot of the Suliman range and the river Indus in Sindh; and eastward the territory is "bounded by a broken line which follows the Nepal Frontier, first along the Sarda and Kali rivers and afterwards parallel with the foot of the Himalaya until it touches the great Gundak river, and from that point by a straight line drawn in a S. S. Westerly direction through Benares and Amerkantak and Bilaspur." The area thus demarcated includes a variety of climatic conditions which are thus described by Dr. Brandis:—

"*First.*—The entire arid regions of India with scanty vegetation and uncertain rainfall, and an atmosphere dry nearly throughout the year (South Punjab, Sindh and the States of Bhawalpur, Kairpur, Bikanir, Jessalmir, and the greater part of Marwar).

"*Second.*—The entire northern dry zone, surrounding the dry region on the north and east, forming a belt from 100 to 200

miles wide, with a normal annual rainfall between 15 and 30 inches, which includes the plains of North and North-West Panjab, outside the sub-Himalayan tract, Delhi, Ajmir, Gwalior and of the Rajputana States, Bhurtpur, Jeypur and Meywar.

Third.—The western end of the north-eastern moist zone, with a heavy monsoon, and an annual rainfall exceeding 60 inches, which comprises the Burmah Coast, Bengal, the sub-Himalayan tract, and the outer ranges. That portion of this moist zone, which extends into the territory of this Flora, is a narrow belt, probably nowhere more than 30 miles wide, narrowing gradually towards the north-west and terminating at the Ravi. It includes part of the Gora kpur and the Northern Oudh forests, the Siwalik tract, the Doons and the outer ranges of the North-West tHimalay.

Fourth.—A portion of the large intermediate region, which comprises the whole of Central and a large portion of the plains of North India, as well as the intermediate Himalaya, which is situated between the outer narrow moist belt, and the inner arid region of Thibet.

Entirely beyond the limits of the present Flora are the southern dry region, including Eastern Mysore and part of the Dekkan, and the moist zone of Western India, comprising the Western Ghats from the Khandeish Dangs to Travancore, the country below the Ghats, and a narrow strip of country above the Ghats.

The total number of species described in the present volume is about 780; of these, three are trees new to science, which were named by Dr. Stewart, and rightly are exotics that have been introduced into India. The principle on which these seven hundred indigenous trees and shrubs are selected for description is as follows:—In arid districts, such as Rajpootana and tracts of the Punjab, every woody plant is of importance, either as a source of firewood or as a part of the scanty clothing of the parched surface of the soil, consequently every such species is described, whereas of districts where the vegetation is more copious, and especially of the Himalaya, only the leading trees and shrubs find a place in these pages. The treatment of this indigenous vegetation is elaborate and satisfactory. Under each species are given a few of its botanical synonyms, its

English name if any, and all the local vernacular names possible. The botanical descriptions are terse, and at the same time graphic and sufficiently full. These are followed for each species by more familiarly-worded details as to the general appearance, time of flowering and fruiting, appearance and quality of timber, its specific gravity and breaking strain, and the other products and properties of the plant generally. The trees forming the most valuable of the tracts in the region with which this book deals are deodar, sal, and teak, and the dissertations on these species are models of thoroughness and lucidity.

Among the introduced plants noticed by Dr. Brandis are several South American species of much interest; some of these are of very old introduction indeed, and are now thoroughly naturalised in garden and village cultivation, but are never found far from human habitations; others again occur every where. It is curious to speculate how some of these could have been introduced. The papaw,* for example, is a Brazilian and West Indian shrub. Seeds of it were however sent to Naples from India in the year 1626 or not long after the discovery of America. The prickly-pear or Cactus† of Europeans is found in waste places from Cape Comorin to Jhelum in the Panjab. Yet it is a native of America. Its rapid spread in India is doubtless due to the agency of birds which eat the fruit. Specimens of the Baobab‡ or monkey bread, a tree of tropical Africa, are found here and there all over India. There is a fine example in the Khadar of the Jumna near Agra, and a still finer exists near Calcutta, the trunk of which girths, at four feet from the ground, 50 feet. This tree was probably introduced, says Dr. Brandis, by early Arab traders. The shrub yielding the Indigo of commerce and the stately Tamarind tree, popularly supposed to be Indian plants, are, as Dr. Brandis reminds us, more probably of African origin. The custard apple and guava are undoubtedly American, and they are in India confined to cultivated spots, or such as have been once so. The subject of introduced plants is a fascinating one, and it is almost a matter of regret that it did not fall within the scope

* Carica papaya, L.
† Opuntia Dillenii, Haw. ‡ Adamsonia digitata, L.

of Dr. Brandis' book to discuss the different weeds, such as *Argemone mexicana*, *Galinsoga parviflora*, *Oenothera rosea*, *Tridax procumbens*, and others, for which we in India are indebted to the Western Continent.

A number of plants are common to Europe and to the North-West of India. The curious *wig** *plant* of the Mediterranean Flora is common in the valleys of Kamaon and Gharwal. The English forester in the middle regions of the Himalaya meets such old friends as the Hawthorn, Yew, Berberry, Ivy, Elder, Birdcherry and White Poplar, while in a more limited area he finds the unsophisticated originals of the well-known Gooseberry and Black and Red Currants of home gardens. In treating of such plants and of others, which have allies in the forests of Europe, occasion is taken to convey much valuable information on European arboriculture. Thus following the description of the tree producing the eatable fig of commerce is a most interesting account of the curious old custom of caprification as still practised in some parts of the south of Europe and Asia Minor. Dr. Brandis' disquisition on the various species of *Citrus* yielding the Orange, the Lime and the Citron, contains the outcome of much interesting research, and gives in a small compass the results of labours of many students of these historic fruits.

One notable feature in the work is, that it indicates yet unelucidated points which are worthy of observation and, enquiry. Prefixed to the volume are a useful synopsis of the characters of the natural orders to which the plants treated in it belong, and also some useful remarks on the structure of wood, and accompanying it there is an atlas (which may be procured separately) of well-executed illustrations of seventy of the more important species from drawings by the celebrated botanical draughtsman Mr. Fitch.

This book should be the constant companion of every forester in Upper and Central India, and any officer of these provinces who gets a quarter of the information contained in it well into his head, and carries it there, may safely congratulate himself as being the most accomplished man in his department with the

* Rhus Cotinus, L.

exception only of our author. What this book does so well for the systematic forest botany of a part of the Indian empire, requires to be done for Indian arboriculture generally, to which an immense impetus would be given by the preparation of a book similar in scope and plan to Lindley's Theory and Practice of Horticulture, in which the rationale of the various operations of forests, including the planting and management of young trees, should be explained *pari passu* with practical details.

Note on Caoutchouc obtained from the Chabannesia esculenta.

By G. W. Strettell.

Reviewed by Sec.

The sphere of work of the Indian forest officer is far more extensive than that of his colleague in any part of Europe. Here he is chiefly employed in providing the people and the state with timber and fuel, whereas minor forest produce is of minor importance, except in rare cases. But in India, what is a forest officer not expected to do and pay attention to? In fact so much so, that very often he has no time for his most legitimate work, what with India-rubber, silk, lac, baobab and bamboo plantations for paper manufacture, vanilla and others. Indeed it may almost be considered a misfortune, that the Indian forests are so rich in valuable minor produce, and so well adapted for the rearing of useful plants, which will not thrive in Europe, because there is great danger of the reproduction of timber and firewood suffering by the tempting receipts from articles like India-rubber and others. This is of special importance, as the Indian forests have already been reduced far below the extent required for the welfare of the people. If a sufficient staff and money were granted, there would be little or no harm in the matter, but as the case stands, the budget allowance is small, and the staff far from sufficient to take care of the forests and to manage them according to sound principles. Hence we feel almost sorry, when some new useful plant has been discovered or some additional experiment has to be made, because every fresh discovery or experiment threatens to rob the more legitimate work of a portion of the funds and of the staff.

Unfortunately new discoveries in this line are usually taken up most enthusiastically by those who make them, and it is very difficult for the authorities to decide how much of the information supplied is reliable and based on actual facts, and how much should be put down to exaggerated expectations. Consequently the usual way of escape from such a dilemma is, "to order experiments to be made on a small scale." Now, these experiments look usually very small on paper, but in reality each of them requires, as a rule, as much attention on the part of the staff of officers, as the management of a teak or sal reserve of a hundred square miles, capable of furnishing all the timber required for thousands of square miles of country around it, and it is not to be wondered at, that we look with great suspicion at every new discovery, which can possibly be brought into connection with the Forest Department. On the other hand, however, we should be very sorry to be misunderstood. Unless investigations are instituted and discoveries are made, we should come to a standstill, which means the beginning of retrogression. No, we are decidedly for progress, but what we should like to impress on those in power is—not to neglect new discoveries—but to be careful that their working up does not interfere with the work already in hand, with other words, that we do not spend the working power of the Forest Department staff in experiments, instead of in the management of the woodlands with the view of averting climatic calamities and of supplying the people of the country and State Departments with timber and fuel. Instead of burdening, therefore, the Forest Department with experiments of the class indicated above, would it not be far cheaper and lead to more satisfactory results, if they were made over to the Superintendents of Botanical Gardens, who are always on the spot, and who could carry them out with much less expense of time, than forest officers, whose duty necessitates their travelling over large tracts of country, putting the constant watching of experiments out of the question.

These rather lengthy remarks have been caused by our reading a little pamphlet on a new India-rubber yielding creeper called *Chavannesia esculenta*, by Mr. G. W. Strettell of the Burma

Forest Department. Considerable attention has been paid of late years to the propagation of the Indian-rubber yielding tree, *Ficus elastica*, which occurs naturally in the forests of Northern and Eastern Bengal, in Assam, and the adjoining parts of Independent Burma. Men of scientific attainments and standing have lost their head over the desire to propagate this species all over the country, and have predicted fabulous financial results up to Rs. 240 per acre annually, which resulted in experiments being ordered immediately. To eradicate such ideas, if once taken up, causes much labor and time to men, who look more calmly at the matter, and who base their calculations on actual and not fictitious facts. Hence we confess we look with some suspicion on similar statements.

The *C. esculenta*, it appears, grows in most parts of British Burma, and it is said to be one of those creepers, for the extermination of which in teak tracts an annual budget provision is made. Some of these creepers, growing near Rangoon and Thamine, were found to possess a maximum girth of 11 inches at the thickest part of the stem, whereas the crown covered an area of 300 square feet, at a supposed age of 5 years. The creeper can be propagated either from seed or cuttings. The rubber, which it yields, has been subjected to some preliminary tests, which *seem* to indicate that its quality is similar to that of *Ficus elastica*. In the last paragraph of the pamphlet Mr. Strettell states, that Mr. Galbraith of Rangoon informed him, "that his chemical tests prove the rubber of *C. esculenta* to be purer and better suited to their purposes, than that obtained from the *F. elastica*." But as it is neither stated what those tests were, or what *their* purposes are, the statement must be taken for what it is worth.

So far so good. But then Mr. Strettell proceeds to say :—

"The foregoing data, then I think, are sufficiently encouraging to warrant the cultivation of this creeper being introduced as a branch of forest administration on an extensive and systematic plan," and he forthwith proceeds to enumerate the following results: "Supposing that 400 acres are planted at 30 feet apart, or 48 creepers per acre, there would be 19,200 creepers in all." He next ESTIMATES the minimum yield of caoutchouc

at 1 viss (3½ pounds) per creeper per annum, or 19,200 viss in all. The price actually offered for the rubber by a Rangoon house is given at Rs. 2 per viss, hence the total annual yield is Rs. 38,400, or Rs. 96 per acre. The expenditure, it is said, will be "trifling in the extreme:" with other words, it is estimated at Rs. 4 per acre per annum for seven years, after which tapping for rubber is to begin, or Rs. 11,200 at the end of seven years. At the expiration of seven years the expenses will embrace tapping, pressing and preparing the caoutchouc, and bringing it into the market, which are estimated at 12½ per cent. of the gross revenue. Thus with an outlay of Rs. 11,200 distributed over seven years, Mr. Strettell expects a nett return of Rs. 33,600 per annum. This is certainly a most splendid enterprise, and if we believed so firmly in the *C. esculenta*, as Mr. Strettell seems to do, we should not hesitate for a single moment, to give up our present occupation, to proceed to Burma, obtain a large grant of jungle land, and plant *C. esculenta* for a limited number of years, with the view of returning to the land of our forefathers as millionaires.

Unfortunately we are not quite so sanguine, and prefer to consider here calmly, in what respect Mr. Strettell's calculation may possibly be open to objection. In the first instance we consider that the expenditure has been under-estimated. Rs. 4 per acre per annum is far too low, and Rs. 40 will probably be found nearer the mark during the first few years, and even afterwards Rs. 4 per acre will not be sufficient to cover all the expenditure to be incurred in tending the plantation. Then again 12½ per cent. of the gross revenue will never cover the expenditure of collecting the caoutchouc and bringing it into the market. In the Darjeeling District, where labor is half as expensive as in Burma, the expenditure amounts, we understand, to about 25 per cent., consequently it is not likely to be less than 30 per cent in Burma, at the very least.

Thirdly, there can be no doubt that the returns have been over-estimated. A creeper may be fit for tapping at the age of 7 years, but Mr. Strettell does not inform us how he has ascertained that each creeper will yield 1 viss (3½ pounds) of caoutchouc annually. A full grown *Ficus elastica* tree, cover-

ing not less than ¼ of an acre, or 10,890 square feet, with perhaps 30 to 40 large stems and air-roots, will yield not more than 5 seers = 10 pounds per annum, if tapped regularly, and it is hardly likely that a creeper of about 12 inches maximum girth covering an area of 300 square feet will yield 3½ pounds per annum. Of course we do not mean to say that the creeper may not yield such a quantity in *one* year, but the *average* yield per annum will, we feel sure, be only a fraction of 1 viss.

Before concluding we consider it our duty to state here as our opinion, that Mr. Stretteil, in bringing to notice a new caoutchouc yielding plant, which, according to the data at disposal, promises to be of importance, has added a valuable contribution towards our knowledge of the resources of Indian Forests, but we would offer him our friendly advice, to abstain on future occasions from over-sanguine expectations and calculations, matters which have already done too much damage to Forest management in India, as to be past over silently.

Sw.

III. Notes and Queries

Transplanting versus direct sowing of Teak.

As the note on this subject by G. M., in the July number of the Indian Forester has been taken up by many correspondents, the original letter of Mr. Ballantyne is here re-printed.—The Editor.

From J. Ballantyne, Esq., Sub-Asst. Conservator of Forests, Maidghat Sub-Division, to the Deputy Conservator of Forests, Berar, No. 8, dated Camp Makia, the 19th April 1871.

I have the honor to state that I tried, in the year 1872, experiments on 120 teak seedlings, ranging from 6 inches to 3 feet in height.

2. The plants were standing in lines at 18 inches apart, and the roots were cut across with a spade at 6 to 8 inches from the surface of the ground; this was done in the month of July. Of the 120 plants, 51 of the smallest died; the large plants lived, but did not make much growth during the remainder of the season

3. During the next season's rains 300 of the plants so treated were transplanted to pits in the Pooli plantation.

4. On being lifted they were found to have fine bushy roots, and could be lifted with a fair quantity of earth adhering to the fibres.

5. Of the 300 transplants, 72 died during the hot season; these were planted on rather dry light soil. Where the soil was deep and retained a little moisture in the sub-soil, the plants lived through the season, but did not make much growth, these are now doing well.

6. The conclusion which I arrived at from the above experiments is, that when the plants are large and strong, and the transplanting ground deep with a little moisture, preparing the tap roots by cutting beforehand is advisable; but when the plants are small and weakly, and the ground where they are to be transplanted to is light and dry, the less interference with the tap root the better.

7. I would here remark that a part of the tap root is always less or more destroyed during transplanting. Good strong one year's seedlings raised by artificial watering, have on an average a tap root measuring 18 inches. Our pits are from 1 foot to 15 inches deep, so it is plain that part of the root must be dispensed with.

At page 56 of the INDIAN FORESTER of July last, I notice that G. M. considers the best size of seedlings for transplants to be from 2 to 3 inches high. He says that the transplanting of larger seedlings has never been attempted, (he writes from Assam). Of course, if he is successful with 2 inch seedlings, it would be no use his trying to transplant 12 or 15 inch plants, as the former can be done for half the cost of the latter.

If G. M. would give a few details, I should feel much obliged, *viz*:—

1*st*.—Rainfall.

2*nd*.—Date of commencement and end of the rains.

3*rd*.—Date on which he would recommend the seedlings to be transplanted from the seed beds to the plantations.

Where I have been planting for the last few years, the rainfall is about 55 inches, the rains last for about 3 months, commencing about the 15th of June, and ending about the 15th or 20th of September.

I try, if possible, to begin transplanting the seedlings from the seed beds about the 10th of July, and have it finished about the 20th, or not later than the 25th.

I like, if possible, to have plants about one foot high; to get plants of this size, I sow the seed one year in advance, for the plants which I planted out this year (July 1875) I sowed the seed in May 1874; about the beginning of May 1875 I commenced artificial watering, and had the seedlings from 2 to 3 inches by the 15th of June, when the rains set in; by the 15th of July the plants were from 9 to 12 inches high. I have never yet succeeded in raising good seedlings by sowing the seed the same season as that in which the plants had to be transplanted to the plantation ground; when the seed has been a year in the

ground, germination commences on the first application of water to the beds.

The above method is, I consider, the best fitted for the locality, where I have been trying to raise plants for some time, but, as G. M. justly remarks, one method cannot be advocated for all the varieties of climate we have in India.

The great objection I find to the raising of plants by sowing the seed at regular distances in the plantation ground at once is, that the plants never do establish themselves firmly enough to stand through the first hot season; during the months of April and May they generally get burned up.

J. B.

In Mysore we have given up transplanting teak, and put down the seed in the spot where it is to grow into a tree. The land is cleared, then lined and pegged out, distance between pegs 6′ × 6′. At time of sowing the ground is worked up, at each peg, with a sharp-pointed stake, and from four to six seeds put down at each peg.

Next year we intend sowing at 4′ × 1′; every fourth row to be not teak, but some other tree which, while shading the ground and forming humus by its leaf deposit, will not overtop the teak.

I believe old teak seed, a year old, to be safer to use than new seed.

G. J. V. S.

Referring to G. M.'s note on the comparative merits of transplanting teak or sowing at stake, I find that here (Bengal) the former method is the most successful, the transplants always appear to make better growth at first than seedlings. I quite agree with G. M., however, in the size at which the seedlings should be transplanted, and I find that plants with just 8 leaves, exclusive of the cotyledonary ones, invariably take root the best. The plants are then hardly more than two to three weeks old, and consequently the tap root is so little developed that there is no danger of hurting it in transplanting. I hope somebody will comply with G. M.'s last remark, as any information on such a

subject, especially from any one acquainted with the plantations of Nellumboor or Kyekpyoogan, would be extremely interesting.

J. S. G.

G. M. may perhaps be interested in the following sketch of an experimental teak sowing in the Satpuras and its result. Here as elsewhere the method of transplanting nursery seedlings was formerly resorted to for filling up blanks and improving forest areas; but owing to the great expense attaching to the system and also to the small measure of success attained by it, transplanting was abandoned, and an artificial plan introduced to supplement natural reproduction identical with that described by G. M., *viz.*, sowing teak seed in small prepared pits or holes 4′ × 6′ or 5′ × 6′ apart.

In the rains of 1873, acres 8 were thus sown, about 12 seeds being dibbled into each pit; very few seeds germinated until the beginning of the monsoon of 1874, when a full crop appeared and were well weeded. Great numbers of these, say one half, died down to the ground during the hot weather of 1874, but at the commencement of the present rains (1875) the same plants threw up new shoots much stronger and larger than those of the previous year. At present about 80 per cent of the pits contain one or more seedlings, varying in size from 6″ to 14″ in height. The plants have this season been weeded twice, and are now sufficiently robust to warrant the hope that with one more cleaning during next rains, they will push ahead without further artificial assistance. The cost of stocking the above area will then have been—

Preparing land	Rs.	98	0	0
Sowing	,,	14	0	0
Weedings four	,,	7	5	3
	Rs.	119	5	3

or Rs. 14-13-10 per acre.

In later and more extensive experiments the above expenditure has been reduced to about Rs. 10 per acre by preparing the land one year in advance of the sowing operations. The ad-

vantage of this arrangement is, that the ground can be more easily worked during the rains than in any other season, and that as a consequence a given work can be completed by the employment of less labour; it also has the merit of exposing the soil to the beneficial influences of the atmosphere, and again, that as it is of great importance when sowing a mixture of teak, sissu, and bamboo or other species to get the seeds of the two last into the ground quickly to ensure their germination early in the season, it is well to have the land prepared and ready for work before the sowing season commences. It is not so absolutely necessary to get the teak sowings finished by an early date, as in these provinces this species seldom germinates until the second monsoon, *i.e.*, the one succeeding the sowings.

J. M.

Memorandum by MR. C. F. AMERY, *Deputy Conservator of Forests, on treatment of tap roots in the Gorakpur Nursery, with reference to remarks at pages* 14, 15 *and* 31 *of* CAPTAIN CAMPBELL WALKER'S *report on English and Scotch Forests.*

I HAVE always regarded it as an axiom in vegetable physiology that tap roots which are channels for the conveyance of food to the trunk may be wounded with much less danger to the plant than would accrue from injury to the fine lateral rootlets which take up the food from the soil, and my practice during the past year has been in accordance with this view. I have seven thousand each of Teak and Toon in the Ramgarh Nursery, nearly the whole of which have been twice transplanted,—once in bedding out from the seed beds when the plants were two or three inches high, and, secondly, when they were from six to nine inches high. At this second transplanting I cut off all inconveniently long tap roots with a sharp knife, and certainly did not lose more than 2½ per cent. of my plants.

I planted also five hundred sâl one evening early in September, cutting off almost every tap root. The percentage of deaths was greater, about 15 per cent., but I attribute this entirely to the extreme delicacy of the lateral rootlets.

The cutting back the tap root in the Nursery is advantageous for plants that are not to be put out the same season, inasmuch as it fosters a more bushy and shorter growth of root, which facilitates the removal of the plant to the field *without injury*, but the operation always causes a shock to the system of the plant resulting in all retardation of growth until the injury is repaired. Nature throws off the leaves to prevent waste and then directs the whole energy of the plant to the repair of the wounded root.

In transplanting finally into the field, every care should be taken to avoid all injury to the roots, for the deeper the tap root descends, the better the hold the tree has on the ground and the greater its sources of water-supply in dry seasons.

Transplanting of Sal.

I SEE that in Mr. C. F. Amery's note on treatment of Tap-roots in the Gorakpur Nursery, circulated in June last among forest officers, that he has succeeded in transplanting 500 sal plants in September last, so I write to ask if Mr. Amery would kindly, through the medium of the "FORESTER," give us some more detailed information on the treatment and transplanting of sal, as so many people have tried it and failed. In 1873, I transplanted about 300 plants with the greatest care, but I do not know of a single one being now alive—they were, most of them, put out in August, and they did pretty well at first. The place was formerly sal forest, and is now partly covered with young natural-grown sal.

J. S. G.

On the Killing of trees.

Reply to note by W. J. S., in July number of the "INDIAN FORESTER."

IN the year 1870 the theory was satisfactorily established that the current of sap in trees and plants takes place in one—the upward—direction only; and that the distribution downwards of the organized nutritive substances depends altogether upon—the agency of diffusion. The principal channel of sap is the albur-

num, by which conveyance also the hydro-carbons are diffused. The diffusion of organized nitrogenous matter is carried on in the scalariform vessels of the liber. If a girdle be cut round a tree which possesses a dead core—or heartwood—the upper portion is deprived of its water-supply, and speedily withers. In the case of trees which have no heartwood, the girdle only modifies vitality in proportion to its depth; short of complete severance the current of sap cannot be broken. Such a tree accordingly continues to live, and if left to itself soon effects a fresh communication between the separated edges of the bark. But if the healing be obstructed, the tree will die by an inverse process, *viz.*, atrophy of the roots, the formation of new cells in which, and storing of the latter with the needful quantity of colloidal substance, depends upon their supply of protoplasmatic (or nitrogenous) compounds. The object of delaying the application of clay to the girdle would seem to be that of introducing a hindrance to the re-uniting of the gap, just at the time when the effort is about to be made.

M. H. F.

Insect Dangerous to Toon.

CAN any of the readers of the "FORESTER" give me some information about the insect which, almost yearly, attacks the young shoots of the Toon tree boring its way along the pith which it seems to live upon, and leaving behind it an unsightly looking mass of a transparent gummy exudation. The larva is white with black and yellow spots, but I have not yet succeeded in finding the perfect insect. It attacks trees both in plantations and in the forests, and prefers these about 3 feet in height and of strong growth. It seems to attack, however, more particularly those trees which grow in cleared land or near roads, while others growing close by in grass or with other trees, have been comparatively unharmed. Any information about its name and habits, as well as the means of preventing its ravages, will be very acceptable.

J. S. G.

Manufacture of Vanilline from the Sap of Conifers.

THOSE interested in the cultivation of 'Vanilla,' about which so much has lately been talked and written in this country, must read with dismay the note at page 321 of the 'Revue des Eaux et Forêts' for October 1874, and page 180 of that for June 1875, which states that the principle of Vanilla 'Vanilline' can be manufactured from the sap of the Scotch fir, silver fir and spruce, and probably from that of all the conifer family. It is not exactly the regular sap of the tree which is used, but the semi-fluid sap which lines the bark at the moment of the latter being detached from the tree. This being the case, what more easy than to collect it at the time of felling and logging the trees in the yearly cutting. The only preparation which the liquid collected has to undergo, is that of being at once boiled for some minutes to prevent fermentation. It is then packed up in barrels and sent to the factories to be used in the preparation of 'Vanilline.' Messrs. Tiemann and Hermann are making experiments with the view of ascertaining the cost of the preparation of Vanilline in this manner, and its value compared with that from the Vanilla plant.

J. S. G.

Cost of cutting and transport of firewood in the Hills.

CAN any of the readers of the "INDIAN FORESTER," who are engaged in the supply of firewood to any of the hill stations of the N.W.P., or Panjab, give, through the medium of your valuable paper, some information on the cheapest system of cutting, transport, etc., supposing the cutting in the forest to be at an average distance of 2 miles from the depôts, with the average revenue and expenditure on every 100 maunds brought to depôt. The yearly cutting block should be considered as nearly on a level with the depôt, though sometimes above, sometimes below.

J. S. G.

On Reclothing the Lower Hills.

THESE few lines on reclothing the lower hills may or may not be found worthy of insertion in the "INDIAN FORESTER;" such as they are I send them to you.

To retree, "as the Americans say," the lower hills of the Himalayan range, not to mention the numerous desolate and dreary wastes, lying in various parts of India, I take to be one of the first and most urgent duties of the Forest Department.

Up to date, notwithstanding the exertions that have been made, I believe no success has been met with. I have therefore now to bring to your notice a tree, which I think would succeed and be admirably adapted for the purpose required, if the seeds can only be obtained; the tree I allude to is a native of South America.

When I was travelling in the Argentine Republic Confederated States some years ago, the tree was frequently mentioned to me, together with its uses, never thinking at the time that I should ever become a forester. I did not pay so much attention to the description, &c., of the tree, as I might have done, but the notes I have of it I herewith describe: if it should prove on trial as successful, and as I am sure it will be found, I shall be perfectly satisfied with the result of this my contribution to the "INDIAN FORESTER."

The tree is called the Algarrobo; its botanical name, I believe, is *Hymenœa*, is indigenous to Spanish South America. It grows to a height of from 30 to 40 feet, has wide spreading branches and slender stem, flourishes best on a dry soil.

In and about the province of Catamorea, where it is most abundant, both the population and cattle depend greatly for support on its leaf and fruit.

The long pods are collected annually and carefully stored for winter use.

When required for use the pods are pounded in a wooden mortar, the meal made into cakes, which being dried are fit for use.

These cakes, if I recollect rightly, are called Patay; are largely exported to other districts, in some of which it is the only food the natives have to depend on during the winter.

The portion of the pods remaining in the mortar after the meal has been extracted, is used with the leaves for feeding cattle, which fatten excessively on it.

It is unnecessary here to dilate upon the inestimable boon, the acclimatization of such a tree would prove to this country, providing, as it does, food for both man and beast.

C. B.

Conversion of Abies Smithiana and Webbiana forests into Deodar forests.

By A Green One.

I know but little of the plains, therefore the hills between the Jumna and Giri Rivers, shall be the country that is principally used in this paper.

On many slopes of the Himalayas large dense forests of firs (*Abies Smithiana* and *Webbiana*) are seen, in numerous instances, situated in places where deodar would be most valuable, though the firs are useless.

Most of these forests of firs are on splendid soil, for the strong young firs seem to have ousted the deodars on to rocky and precipitous or exposed parts.

I wish to suggest that these forests can, at small expense, be converted into deodar forest, mixed slightly with evergreen oaks and decidous trees.

The manner I suggest setting about it is, to cut broad slanting lines across the hill sides cutting out all the firs, but leaving oaks and other kinds of trees sparingly.

Lines must never be cut straight up and down because of wash and snow. The lines would have to be cut in a different bearing on nearly every hill side, so as not to allow too much or too little sun to get at the ground.

Width of lines would also vary with height of standing crop, angle of slope, nature of soil, elevation, aspect, dampness, &c.

The felled firs might, in some cases, be profitably used up as charcoal or fuel for lime burning, but in most cases it would be left to rot.

If the fellings are to be used, it would be better to begin in the top line, as the wood most likely would be rolled down to export roads or lime kilns.

Having the forest lined off by blazed trees on narrow paths, begin felling at the top, and sow as soon after the felling as possible, so that the seeds may germinate at once.

When the first sowings are up to two feet make your lines broader, and by increasing them 10 feet in width each year, or if seed is scarce, wait until a plentiful year comes, and then increase all at once.

On the Rearing of groves of Nim trees in Oudh.

EXTRACT FROM THE OUDH GOVERNMENT GAZETTE, DATED 26TH JUNE 1875.

From Captain C. S. Noble, Assistant Commissioner, Unao, late Officiating City Magistrate, Lucknow, to the Personal Assistant to the Chief Commissioner, Oudh, dated Unao, the 6th May 1875.

IN accordance with your No. 3380, dated 2nd August 1871, Revenue Department, addressed to me personally, I forward a report on the experiment of rearing groves of "nim" trees without artificial irrigation, in the method described in Secretary Chief Commissioner, Central Provinces, Circular 47, of 18th July 1871.

2. The spot selected for the plantation was in the Residency grounds—the highest and driest site to be found in Lucknow. The "nim" and "arhur" seed were sown in the month of July 1872, after the ground had been twice ploughed up. This was under my personal superintendence.

3. In December 1872, I was removed to another appointment, but on leaving Lucknow gave careful instructions to the Residency máli to abstain from giving the trees any water, and to confine his interference with the seedlings entirely to keeping them free of weeds. These instructions, from enquiry on the spot, I find were attended to, and, at all events, not a drop of artificial irrigation was given to the plants. Captain Newbery,

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in his No. 1803. dated 1st instant, has forwarded to you copies of short notes of the progress of the seedlings, but as Sir George Couper had in his Secretary's letter, referred to in the commencement of this letter, asked me to give my personal attention to and report on the experiment, I now do so, sending this through Captain Newbery's office.

4. I inspected the plantation at the end of last month, and am glad to report the experiment has proved a success. The nim trees, though they were sown only two years and nine months ago, are now looking very healthy and hardy. The growth has been a great deal more rapid than I had been led to anticipate after reading the remarks of Mr. Craw, addressed to Officiating Inspector General of Forests, and forwarded with the circular of Chief Commissioner, Central Provinces, already alluded to. Many of the seedling trees are now 7 and 8 feet high, a growth quite as rapid as, if not more so than, that of similar trees transplanted from nurseries to road avenues, and there carefully tended and watered. What I am most struck with is the straight, even growth of the trees. I always found that in trees transplanted to road avenues, there was a troublesome tendency to excessive lateral growth, by which growth in height was much retarded. In this plantation the trees, being close together, have grown upwards with straight stems, and thrown out but few side boughs. One great advantage in this method of growing trees is that the roots, not being artificially supplied with water, grow downwards a great depth in search of that element, thus giving them a greater hold on the ground when assailed by high winds in the rainy season. This deep growth furthermore, as Mr. Craw says in the correspondence forwarded by the Central Provinces' Government, makes these trees "better able to withstand occasional drought than seedlings whose roots have been kept near the surface by artificial waterings."

5. The experiment now reported upon has conclusively proved that however dry the site chosen, provided it be unassailable by floods and cattle, "nim" trees can be grown successfully in the manner described by Colonel Keatinge. Moreover, I think it would be a cheap and good system to follow wherever groves are required for camping grounds (paraos) on district

roads. A grove might be arranged for in the following manner :—

I.—After selecting a site unlikely to be flooded during the rainy season, enclose the area intended for the grove by a bank of earth thrown out of a ditch 3½ feet deep by 5 feet wide. No path way should break the continuation of the enclosing ditch.

II.—Top of bank to be sown with babúl seed in four rows, one foot apart, all round the enclosure.

III.—Plough up the enclosed land two or three times, then sow the nim and arhur seed in the manner described by Colonel Keatinge.

IV.—Inside enclosing bank, and on all the four sides of enclosure, plant a single line of alternate bargat, pipal, gular, and sisham trees. These are rapid-growing trees, and favorites with the natives.

V.—Entertain a máli for 18 months from date of sowing until babúl has grown strong and thick enough to keep out cattle. Say the sowing would take place early in July, the máli need not be entertained until middle of following October, and his services dispensed with eighteen months after date of his entertainment.

His duties would be to—

(*i*).—Keep the weeds clear of the seedlings.

(*ii*).—Re-sow arhur seed the second season when the old arhur plants are worn out.

(*iii*).—To water the burgat, sisham, pipal, and gular plants only.

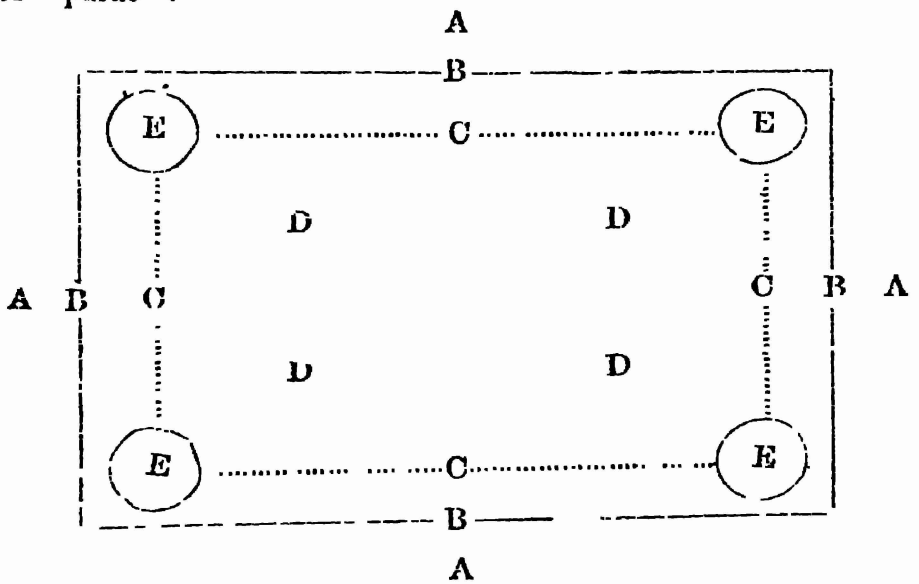
VI.—The babúl fence should be thinned the third year, thinned again the 4th and 5th years, and entirely cut away and removed the 6th year if the nim trees are sufficiently grown to be unhurt by cattle trespass.

VII.—The nim trees should not be thinned nor pruned until the third year, when two out of every three might be cut down. Thinned and pruned the 4th and 5th years, and finally thinned the 6th year. It is hoped the grove would be fit for public use by spring of the 7th year.

VIII.—A good clump of bamboo trees might be planted inside the enclosure, at each of the four corners.

IX.—The sale of babúl wood and young "nim" poles would go towards cost or building a good pucka well in the enclosure in the seventh year, when the grove is thrown open to the public.

6. Below is a sketch of the proposed arrangement for an enclosed plantation, to be subsequently used as a camping ground or "parao":—



A—Ditch outside the enclosing bank.
B—The bank sown with 4 rows of babúl.
C—The line of sisham, burgat, pipal, and gular trees.
D—Centre space to be ploughed and sown with nim and arhur.
E—The clump of bamboos.

From the Officiating Deputy Conservator of Forests, Bahraich Division, to the Conservator of Forests, Oudh, No. 33, dated 26th May 1875.

SUBJECT.

Nim plantation without artificial watering.

I HAVE the honor, in answer to your No. 15, of 3rd May 1875, to report that in June 1872, one acre of nim was sown with arhur seed in alternate rows as ordered in your letter No. 626C.

of 21st November 1871. The result has been very successful. The young seedlings are now from 1 foot to 12 feet in height, after barely three years' growth. The plantation has not been artificially watered.

I have the following memoranda to record: most of the arhur died, chiefly from frost, in December 1872, but saved the nim seedlings, then three or four inches high. In 1873 rains the arhur somewhat recovered, but died outright in the latter part of 1873

The nim suffered very much from frost in January 1873, recovering in the rains of 1874. In December 1874 the nim suffered again from frost, and numbers of the small seedlings died. On the 17th of the current month, I examined and measured the nim seedlings; there are about 600 young saplings, which have thrown out new shoots from where they were frost-bitten.

From the above you will perceive,—*1st*, that arhur will not last more than 18 months at Motipur; and that, *2ndly*, nim suffers severely from frost.'

I cannot at this moment account for the marked difference in growth, namely a large number of seedlings, now only 1 foot high, and some as high as 12 feet, a great number from 5 to 10 feet high. Another thing I noticed was that to the south of the existing indigenous old sal and ebony trees that were not felled in this acre of nim, the nim is more hardy and prolific and thick.

To me, as an observer on the spot, it appeared that nim should be sheltered from the north winds.

Working of the New Forest.

From the Pall Mall Budget.

In a report from Messrs. Mathews, Murton, and Menzies to the Lords Commissioners of Her Majesty's Treasury relative to the Royal forests, which has just been printed, attention is called to the system under which the large timber is now supplied to the dockyards from the new Forest; a system which is said to be "open to serious objections, as it is at variance with all the principles which regulate commercial transactions between one department and another." A certain quantity of timber is required for the Navy: the entire forest is searched for the best trees, which are taken down without

any reference to what is around and about them, and broken into "thick stuff" or "plank" by the forest servants (whose business is, or ought to be to grow trees, and not to be converters of timber), and accepted or rejected at the caprice of the Navy purveyor, it being notorious that one purveyor will reject what another will accept. The rejected timber is then sold to the general merchant at such price as an article with a discarded brand upon it may be expected to realize. This system, says the report, is vicious too, inasmuch as it inflicts a greater amount of damage upon the forests than is compensated by the advantages gained by the Navy. The Navy Department should not be permitted to require more than the forests can supply with a due consideration of their permanent welfare. All trees should be sold standing; and whenever the deputy-surveyor has selected any given area for clearance, the purveyor for the Navy should have the privilege of putting his mark upon any trees he chooses to select, and those so marked he should take and remove within a given time. The deputy-surveyor would then have to deal with the general merchant for the remainder, and the space so cleared would come regularly into course for replanting.

Treatment of Ornamental Trees.

Extract from the Gardener's Chronicle.

It may be worth while to state the great success I have had in a mode of treatment of large, old and ornamental trees on a lawn and area of ground adjacent to a residence, where it is a great object to preserve such trees in a state of vigour to guard against the commencement of decay. It is desirable to state in the outset that where leaves are annually removed in order to keep a place in nice condition, trees are deprived of their natural nourishment, but even when not removed they are blown about so as to render them of little or no avail in affording food and nourishment to the roots of the trees. It is also clear that these trees have been grown for 100 to 150, or a greater number of years, and where the soil is not perhaps very good it must necessarily be exhausted and impoverished. Therefore after a long period has elapsed, it is not to be wondered at—on the

contrary it is to be expected—that time will tell on the trees, and that they should show symptoms of standing still in their growth—of a stationary condition at least in the first instance, and subsequently of the commencement and advance of decay. These considerations attracted my attention years ago, and created a desire to arrest such downhill progress, and devise a remedy, at the same time to steer clear of any experiments which might prove injurious. One of the symptoms I observed, especially on lime trees, was an increasing smallness of the leaf and a shortness of the annual shoots. I set to work some fifteen or eighteen years ago to give some safe treatment to the trees. Without stirring the existing surface, I began to lay on around the stems of the trees, and at least as far round as a circle with a circumference rather beyond the extremities of the branches, a coating of good earth with which some lime had been mixed. The compost, which was laid on about 5 inches thick when loose, gradually became solid, and remained about 3 inches thick. There was no difficulty in giving this amount of compost to a small number of trees; but it was obvious that earth could not be found within a moderate distance to apply the same treatment to a large number, and that the cartage, even if it could be found, would be a large expense if twenty or thirty cartloads were to be applied to a large number of trees. But as regards the trees to which this treatment was applied, the result was most satisfactory. The earth being laid on in the winter and spring no effect was visible in the first summer; but in the second summer the leaves were double their former size, with quite a new vigour; in the third year the leaves, which had before been little bigger than half-a-crown, were four times that size, and some of them almost as large as dessert plates, on thick and succulent shoots. To a certain extent similar results were attained, but on no tree was the difference so great as on the lime tree, as all the fine fibres of the roots pushed up into the new soil and nutriment. But I was desirous to see how a similar result might be attained by a less expensive and laborious process, so that the effect might be kept up and extended to a greater number of trees. I bethought myself of a very simple and cheap process, which

I have now practised for a succession of years with most satisfactory results. The leaves of the whole of the trees must be cleared at all events, in order to keep the place in nice order, and the practice I have followed is to rake all the leaves off a certain area round the stumps of about one-third of the whole number of trees within a certain space, and to place a coating of leaves about 7 inches thick in a circle from them to a circumference as far as the branches extend. This will gradually sink down to a coating of 3 inches of solid and decaying leaves; and thus there is created a coating of decaying leaves or leaf-mould—the most appropriate food of trees. Into this coating the root fibres push and are sure to find their best nutriment, the youth of the tree is renewed, and a new lease of life seems to be given to it, with all the vigour of youth and the strength and magnitude of manhood. If a little earth or vegetable rubbish can be laid over the leaves it secures their not being scattered by the wind, and a few branches of trees will assist in this object—these can be removed when the leaves are somewhat consolidated. I can state with truth that on a mass of large trees, which I have had thus treated, I see an increase in the size of the trees and quite a new vigour in their growth. It is my intention to repeat the treatment once in three years, to keep the gentle action of the nourishment of the trees in the wood and outlying trees to which I mean to apply it. I consider that the leaves will afford the means and necessary supply once in three years to the whole of the trees. Much more might be said, but already this statement is too long, and persons who may take an interest in the subject will readily think for themselves, and see how simple a matter it is to confer a benefit on favourite trees. *T. F. P.*

Fleischmann's Hypsometer.

Mr. Ribbentrop, in the Report of the Forest Conference in the Punjab in 1872, describes Fleischmann's Hypsometer, but he does so in such brief terms as to render us unable to make one here in our workshops. Perhaps Mr. Ribbentrop could find time to publish a somewhat more detailed description and sketch of it. G. F.

IV. SHIKAR AND TRAVEL.

My first Tiger.

WE were out bear shooting in hilly country bordering on Sonthalia, and first-rate bear country it is—bear plentiful, and the Sonthals the most plucky of beaters.

I have known an old Sonthal, when one of our beaters was attacked and thrown by a bear, rush in unarmed with nothing but a bamboo *lathie* and belabor the bear till he left the prostrate beater and took to his heels. The beater was badly mauled, but the old Sonthal's pluck saved his life.

Well, on the occasion of which I write we had a bad morning, the bear broke back through the line, or else with disagreeable obstinacy ran down the hill without coming near, where I and the other gun were posted. At last a big fellow broke in front of me, and I could swear that he carried off the contents of each of my barrels, but there was, as is so often the case with bear, no immediate visible effects, and bruin vanished in the jungle behind me; this was a mere patch, and I could see beyond and around it and knew that he did not leave it. We therefore searched it well, but the beaters were careless, it was nowhere to be found, and they accordingly came in for the abuse of the discontented. A day or two after the bear was found, in that very spot dead and all powerful in smell; vultures indicated his whereabouts.

The morning had been profitless, the sun was very hot, and I proposed a return to camp. D., however, who had arranged the day for me, suggested beating one more hill. We had some 500 beaters out, and he said he had certain *kubr* of bear with possibility of a tiger, one having of late been seen in the hill he wished to try, and that although no preparations had been made on this hill for michans, he had shot on it some months back and knew that two old michans, which would answer our purpose, still stood there.

I had never shot a tiger, never seen one in its natural state, and this was tempting. So mounting our horses we rode off in the direction of the supposed tiger's stronghold.

As this part of India abounds in tiger, and our yearly returns of deaths caused by them was something exceptionally high, it may seem strange, that shooting constantly as I did I had never come across one. The reason was that the jungles which they kept to were too dense for beating with men, and we had no elephants. In fact almost the only elephant in the district, and a grand tusker he was, I had to shoot, as he went "pagla," killed three people, and was busily employed pulling down villages, when the villagers came and begged me to shoot him. There were no other elephants far or near with which we could recapture him, so I had, for security of life and property, to kill him, greatly as I regretted it. It seemed from what D. said as if there was at last some hope that I might sight a tiger, but I did not feel very sanguine; the beaters had been very careless that morning, and I feared that the knowledge of a tiger being in the hills would not improve them. We were not long in getting to our new scene of operations. There was a narrow straight low hill over a mile and half in length, just at one end there was a dip on the top of the hill forming a kind of nest over which a pathway ran, and here we found two old michans—more rickety old affairs I never saw. They stood right and left facing the length of the hill, and owing to the track they were on being in the dip, they had to be high, so as to command the ground in front, and accordingly they were some 20 feet high. They stood apart supported by no growing trees; were old and unsteady; and altogether looked two of the most unlikely conspicuous places from which to shoot. Their position however was first rate, as they commanded the ground in front and the slopes on either side of the hill, so that with good beating any beast in the hills, unless it broke the line, must come in our range.

I had choice of michans and selected the left hand, the reason being that the nature of the ground concealed it a little more than the other one. The tract here ran deep in the dip, and before my michan, and only some 6 or 7 yards from it, was a rocky bank

like a wall on the side of the path; it was covered with low scrub, and the platform of my michan was thus about on a level with the top of this bank from which the ground in front ran unbroken along the hill top, and I could see well through the different openings in the jungle before me.

The beaters were all sent round by circuitous routes in the valleys to the far end of the hill, where they were to form line across it and drive right up to us. It would take them some time to get in position, so I preferred sitting at the foot of the ladder of the michan, to getting up into it sooner than was necessary. I laid my gun on the grass before me, dismissed chuprassies and gun-bearers, who went quietly down into the valley, and in a few minutes not a sound was to be heard in the still hot midday air; it was exceedingly oppressive, the very birds hopped lazily with extended beaks panting with the heat, and the insects seemed overpowered. Presently the great stillness was broken by the faint sound of a far off whoop from one of the Sonthal beaters, and I knew that the drive had commenced. There is something peculiarly pleasant and exciting in the commencement of a beat. That great stillness, broken only now and then by the sound of a beater's call which warns you they are on the move, the straining of sight and hearing to catch the first rustle of some wild beast as it moves stealthily from the disturbance in its rear, or to get the first glimpse of its skin and then the expectation. There is no saying what may break before you, and you are quite convinced that something worth getting will do so.

It was time for me to climb up into my michan, and I was just about to do it, when a slight movement ahead of me and on the top of the bank, over which I could not then see owing to my being on the ground, made me take up a rifle and stand expectant. It was a moment of excitement, but alas, it was no tiger, no bear, but an almost breathless chuprassy—a man we had sent with the beaters. I was beginning to ask rather angrily what he meant by being thus in front of the line, when coming close up to me he whispered, "Burra bagh hai Sahib;" he was a thoroughly plucky fellow that, when with the beaters they had sighted a tiger, and he had alone come on ahead to give me

the welcome news. It was impossible to be angry with him, so telling him to get sharp down into the valley I mounted the michan. I had not been seated very long when far up an opening in the jungle I caught a momentary glimpse of a striped animal. It was the tiger ahead of me, and evidently coming down in my direction. How glad I felt that I had taken D.'s advice and not gone back to camp, and oh how I longed to see that tiger nearer, and how I feared lest it should go to D. and not to me!!! Then followed minutes of anxious waiting; nearer and more often come the beaters' cries, but no more could I see of the tiger. Presently a breath of wind wafted up the sound of many shouts and great confusion; could it be that the tiger had broken back and through the line? Then all was again still—not a sound. Suddenly I saw D., whose michan was only about 50 yards from mine, and who I had all along been watching jealously with half an eye, raise his gun and take a deliberate aim. Could it be the tiger? I devoutly hoped not, but then if it is only a bear. I thought he may scare away the tiger by firing. Why on earth does he not fire and have done with it? What made him take that aggravating long sight; he is coming a little to his left, my direction; down goes his gun—he looks disappointed. Hurrah, it must be that he only caught uncertain glimpses of the tiger as it passed along, and that it is coming towards me and out of his line of fire; eagerly I scanned every inch of ground in front of me, expecting every moment to see the beast—when what is this? Oh bitter the disappointment! Up goes D.'s rifle again! My feelings were tumultuous—jealousy I fear uppermost, evidently I think shooting is at times jealous work, especially with beginners, before one has shot so many head of big game that you can afford pleasure in seeing your friend successful—yourself the reverse. Let men say what they will; many are the breakers of the 10th commandment in the field, for I defy a novice not to feel covetous of his friend's opportunities. I know on this occasion I felt very uncharitable, and it was no improvement to my state of mind to hear bang bang from D.'s rifle answered with a loud angry roar, and to see a splendid big tiger charge down the slope of the hill and into the valley—D. having seized another rifle and aiming at

him all the time. Better be killed by D. than get off I thought, and I could not understand why he did not fire. I saw, and could do nothing. I longed for a flying shot, but D and his michan were in the way; down went my spirits to zero, the tiger seen and lost. I felt horridly disgusted; no further hope; as well shut up and go home; but what was that I suddenly saw. A party of some 12 Sonthals armed only with *latties* rushed out of the valley and up the slope of the hill shouting and yelling to meet the descending tiger; it was very plucky, and I know, no people but Sonthals, who would have done it; the effect was magical. The tiger could not face so bold a front, and with a deep growl of rage and disappointment he turned and charged up the hill again, and made straight line for the front of D.'s michan. The line of beaters was now near, and the noise all round great, and the tiger so hemmed in that if he did not attempt to break the line he must come right in front of us, but alas it was D.'s chance, not mine. Up rose the demon jealousy—was D. to have all the fun, I none? How eagerly I watched him. The tiger had now got under cover of the jungle, and I could see him no longer, but I could see that D. saw it, was watching it, and was preparing for another shot!! There goes his rifle again, a deliberate pot it looks like. Hang him, why does he not fire and take his chance; the apparent deliberation of his aim was maddening; it seemed to say, "Just wait, my one shot now will settle this business; you are out of the sport!!" Would that his gun would miss fire!! The tiger is now evidently crossing his front and coming on to me, and if he will only miss, my chance may yet come!! But it is not to be. Crack—sharp rings out his rifle—a pause—crack again. Eagerly straining forward he seizes his other gun; again he sights well, clearly the beast is not dead, that is satisfactory, but is it down? Is he only meditating another shot for safety? Does he see it? What can it be? I would have given worlds to have shouted and asked him. I see his rifle go down, but he is stretching forward and straining his sight ahead of him. How eagerly I watched him every movement, was my poor little chance all over? Some such thoughts were flashing through my mind when my attention was taken in a moment from D. by hearing a slight movement before me.

In my anxiety and watching D. I had forgotten my own front; I now turned to it, and with a thrill of most intense delight I saw before me, on the very edge of the bank, the tiger!!! He was crouching as if on the point of springing into my michan, and he could easily have done it, his head towards me, his whole body still, except his tail that moved angrily from side to side, his teeth bare as with jaws partly extended, the ivory shone white from under his blood red lips, his large eyes flashing green fire. I felt as if his breath was almost on me, as if he was almost in my michan; it seemed touch and go; that longed-for moment had come, hurrah!! Blessed be Jupiter. Whatever D. had done, it was not his rifle that was to bring down the splendid beast after all!! I pressed my left trigger, —bang— an ounce of lead pierced the tiger's brain, and he simply subsided; the light died out of those large eyes, the head fell forward, the tail was motionless, and he lay on the rock in the very attitude of springing. My first tiger was dead!! I have never since felt the same pleasure in the death of any tiger, as I did that. All the time it was not really my tiger, as D., who is a good shot, had put two bullets into him, though not giving a mortal wound, so the skin was his; very good-naturedly he let me have the skin. it was a very large and handsome one, to have it better preserved I sent it to Calcutta. I had better have left it to our mofussil worker, as when I got it back it was quite spoilt and not worth keeping.

Of the triumphant return to camp, the tiger slung to a good stout pole and carried by many Sonthals, while tom-toms were sounded and great noise pervaded I need not write; few of my readers have not, I imagine, seen such sights.

R. M.

V. EXTRACTS FROM OFFICIAL GAZETTES.

As the Editor has not received the Gazettes of Mysore, Assam and Madras, the following list will not be found complete :—.

1.—GAZETTE OF INDIA—

The 30th July 1875.—No. 2382.—The Governor-General in Council is pleased to sanction the following addition to the rules for the grant of travelling allowance to officers of the Forest Department elsewhere than in the Madras and Bombay Presidencies. Daily allowance cannot be drawn by Forest Officers for excursions made to places less than ten miles distant from their head-quarters. Mileage cannot be drawn for a journey of less than thirty miles in one day.

The 11th August 1875.—No. 886.—With the consent of the Goverment of the North-Western Provinces, and with reference to paragraph 7 of the Resolution No. $\frac{20}{557-573}$, dated 3rd instant, by the Government of India in this Department, *Mr. O. Greig*, Sub-Assistant Conservator of Forests in those Provinces, is attached to the Forest Survey Branch for a period of 12 months.

The 10th September 1875.—No. 1018.—*Mr. O. Greig*, Sub-Assistant Conservator of Forests in the North-Western Provinces, who, under Notification No. 886, dated the 11th ultimo, was attached to the Forest Survey Department for a period of 12 months, joined that Department on the 1st instant.

2.—CALCUTTA GAZETTE—

The 2nd August 1875.—*Dr. W. Schlich*, Conservator of Forests, Bengal, is allowed leave for 42 days under Section 21, Chapter VI of the Civil Leave Code, with effect from the 10th August 1875.

Mr. A. L. Home, Deputy Conservator of Forests, Soonderbuns Division, is appointed, in addition to his other duties, to have charge of the office of Conservator of Forests, Bengal, during the absence, on leave, of *Dr. W. Schlich*, or until further orders.

The 14th September 1875.—*Dr. W. Schlich*. Conservator of Forests, Bengal, having returned to duty on the afternoon of the 9th September 1875, the unexpired portion of the leave granted to him under orders of the 2nd August 1875, and published in the *Calcutta Gazette* of the 4th idem, is cancelled.

Mr. A. L. Hume, Deputy Conservator of Forests, Soonderbuns Division, will continue to hold charge of the office of the Conservator of Forests, Bengal, in addition to his other duties, till the return of Dr. W. Schlich from the conference of Forest Officers, or until further orders.

3.—NORTH-WESTERN PROVINCES GAZETTE—

The 28th June 1875.—No. 99F C.—With reference to Notification of the Government of India, Department of Revenue, Agriculture and Commerce, No. 560, dated 12th ultimo, *Mr. E. P. Dansey*, Assistant Conservator of Forests, 3rd Grade, reported his arrival at Naini Tal on the 10th instant, and has been posted from that date to the Garhwal Forest Division.

The 29th June 1875.—No. 100F. C.—With the sanction of the Government of India, *Mr. C. Bagshawe*, Assistant Conservator of Forests, 1st Grade, is promoted temporarily to the 3rd Grade of Deputy Comsservators, to fill a vacancy, with effect from the 7th April last

No. 101 F. C.—*Mr. A. R. Grant* is temporarily promoted from the 2nd to the 1st Grade of Assistant Conservators of Forests, with effect from the 7th April last, *vice* Mr. C. Bagshawe.

No. 103 F. C.—The following promotions in the Forest Department of the North-Western Provinces are made with the sanction of the Government of India, with effect from the 1st April 1875.—

Mr. C. F. Amery, from the 3rd to the 2nd Grade of Deputy Conservators.

Mr. A. Pengelly, temporarily, from the 2nd to the 1st Grade of Assistant Conservators.

Mr. L. A. W Rind, from the 3rd to the 2nd Grade of Assistant Conservators.

The 3rd July 1875.—No. 177F.—With reference to the Government of India Notification, No. 534, dated 4th May 1875, of the Revenue, Agriculture, and Commerce Department, *Mr. R. H. C. Whittall*, Assistant Conservator, 2nd Grade, proceeded to join his appointment in Burmah on the forenoon of the 16th June 1875.

The 19th July 1875.—No. 131F. C.—Privilege leave of absence for one month is granted to *Mr. O. Greig*, Sub-Assis-

tant Conservator, Jaunsar Forest Division, with effect from the 20th instant, or such subsequent date as he may avail himself thereof.

The 21st July 1875.—No. 191F.—*Mr. R. P. Colvin*, Deputy Conservator of Forests, 1st Grade, has been granted by the Right Honorable the Secretary of State for India three months' leave of absence on medical certificate, in extension of the leave granted to him by this Government, in Notification No 120F.C., dated August 1874.

The 6th August 1875.—No. 146F.C.—With reference to Notifications Nos 100, 101, and 103F. C., dated 29th June last, *Messrs. O. Bagshawe, A. R. Grant*, and *A. Pengelly*, are promoted to officiate in temporary vacancies instead of being promoted temporarily in the grades mentioned.

4.—PUNJAB GOVERNMENT GAZETTE—

The 6th July 1875.—No. 207F. *Promotions.*—The following promotions are made with the sanction of the Government of India, with effect from the 1st April 1875:—

Mr. G. Duff, Deputy Conservator of Forests, 3rd Grade, to be Deputy Conservator, 2nd Grade. *Mr. E. Forest*, Assistant Conservator of Forests, 3rd Grade, to be Assistant Conservator, 2nd Grade.

Mr. F. O. Lemarchand, Assistant Conservator of Forests, 3rd Grade, to be Assistant Conservator 2nd Grade.

The 2nd August 1875.—No. 246F.—*Promotions.*—The following Assistant Conservators of Forests, 2nd Grade, are, with the sanction of the Government of India, promoted to officiate in temporary vacancies as Assistant Conservators of the 1st Grade, with effect from the 1st April 1875:—

MR. W. RIGHY.

MR. C. F. ELLIOTT.

5.—OUDH GOVERNMENT GAZETTE—

None.

6.—CENTRAL PROVINCES GAZETTE—

The 22nd July 1875.—No. 2542.—*Mr. W. Jacob*, Deputy Conservator of Forests, on his return from the one year's furlough granted to him was attached to the Conservator's Office, from the 12th to 21st June 1875.

Mr. Jacob assumed charge of the Central Division from Mr. A. Smythies, Assistant Conservator, on the 26th idem.

The 5th August 1875.—No. 2747.—The privilege leave of absence granted to *Mr. H. Leeds*, Deputy Conservator of Forests, in Notification No. 2037, dated 10th ultimo, is cancelled at his own request.

The 19th August 1875.—No. 2941.—*Mr. W. P. Thomas*, Assistant Conservator of Forests, availed himself of the three months' privilege leave granted to him by Notification No. 2038, dated 10th June last, on the 31st ultimo.

7.—British Burmah Gazette—

The 12th July 1875.—No. 73.—*Mr. L. A. W Rind*, Assistant Conservator of Forests, 3rd Grade, having reported his arrival at Allahabad on the 25th March last, for duty in the North-Western Provinces, the unexpired portion of the leave on medical certificate granted to him in Notification No. 62, dated the 18th March 1875, published at page 56 of the *British Burmah Gazette*, Part II., is cancelled.

8.—Bombay Gazette—

The 28th June 1875.—*Mr. W. J. C. Dunbar*, 3rd Grade, Assistant Conservator of Forests, is promoted to the 2nd Grade, with effect from the 20th April last.

The 12th July 1875.—*Messrs. Narayan Balal Oake*, Sub-Assistant Conservator of Forests, 1st Grade, and *G. Hewett*, Assistant Conservator of Forests, 2nd Grade, respectively delivered over and received charge of the District Forest Office of Colaba and Dapoli on the 8th July 1875, after office hours.

The 26th July 1875.—*Mr. W. H. Horsely*, C. S., Assistant Collector, Khandesh, and *Narayan Balal Oake*, Sub-Assistant Conservator of Forests, 1st Grade, respectively delivered over and received charge of the District Forest Office of Khandesh on the 22nd July 1875, after office hours.

The 20th August 1875.—*Mr. Gibson*, Assistant Conservator of Forests, Tanna, is allowed privilege leave of absence for three months.

The 25th August 1875.—*Mr. J. McL. Campbell*, Conservator of Forests in Sind, has been permitted by the Secretary of State for India to return to duty within the period of his leave.

The 6th September 1875.—The privilege leave of absence for three months granted to *Mr. Gibson*, Assistant Conservator of Forests, Tanna, in Government Notification, dated 20th ultimo, is cancelled at his own request.

Plate I.

H. Kurz Del.

S. Sedgfield Lith.

Plate. II.

S. Kurz. Del.

S. Sedgfield. Lith.

INDIAN FORESTER.

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Bamboo* and its use.

By S. Kurz.

No plant is known in the tropical zone which could supply to man so many technical advantages as the bamboo. The strength of the halms, their straightness, smoothness, lightness combined with hardness and greater or less hollowness; the facility and regularity with which they can be split; the different sizes, various length and thickness of their joints makes them suitable for numerous purposes to serve which other materials would require much labour and preparation. To this must be added their abundance and the ease with which they are propagated. They are, as Mr. Alf. Wallace writes, at once the most wonderful and the most beautiful production of the tropics, and the best gift of nature to uncivilized man. Who never has travelled within the warm zone of our globe, can form only a very superficial idea of the real importance of bamboo. Wherever we cast here our eyes, these gigantic grasses meet us either in their natural state or by the industry of man transformed into the most varied objects. Without bamboo the Indian would be poor, very poor indeed!

The present demand for bamboo in forestry and manufacture, and more especially the recent agitation to use bamboo in the fabrication of paper, etc., may well excuse me if I have taken upon me the task of treating, however incompletely, not only the uses of these arbereous grasses, but also of offering some remarks on their general growth and habits, as well as on their specific differences. As however my researches of the British Indian and Eastern Asiatic species are not yet closed, I shall

* The vernacular names for bamboo generally are bans, *Bengali*; bamboo, *Malay*; awie, *Sundanese*; tring, *Javanese*; utte, in the Moluccas; Kây, *Siamese*; Wa, *Burmese*; chack or chouw, *Chinese*.

for the present treat those of the Indian Archipelago and of the Malayan countries. In doing so I include now already such general remarks on the continental species, as may not interfere with the special object under view.

The heads under which I arrange the matters connected with the practical treatment of bamboo, are the following:

1. Use of bamboo generally.
2. Habit and growth of bamboo.
3. Species of bamboo.

   a. Those of the Indian Archipelago and Malaya.
   b. Those of China and Japan.
   c. Those of the Indian Continent and adjacent islands.

I.—Use of Bamboo generally.*

One of the most important and prevalent applications of bamboo takes place in house building. Indeed, Indians might be classed into those that use bamboo in the construction of their dwellings, and those that use brick, mud or wood. The dreary aspect and poor condition of the people in mud-houses must gravely press upon the mind of those that have had opportunity to study the habits and healthy condition of the people that live in neat bamboo-houses.

It is of the greatest importance in applying bamboo for any building purpose, to see that the halms are cut in the proper season of the year. If cut just before the rains, they will be nearly eaten up by weevils ere the rains close; but if felled at the close of the rains, they will often remain strong, and proof against the attacks of xylophagous insects, for 6 or 7 years. Immersion in water for a few weeks before use is generally adopted by the natives and renders them more

* Besides my own observations and those of friends, numerous books were consulted in the compilation of the uses, but chiefly the following treatises:

A. Wallace, on the bamboo and durian of Borneo (in Hooker's Journ. of Botany, VIII, 225 sqq.)

M. C. D. Edouard Mène Utilisation des bambou en China, (Journ. of Acclimat. Soc. of Paris).

Junghuhn's Java, F. Jagor Reiseskizzen Singapore, Malacca, and Java, and various articles contained in the volumes of the Transactions, Journals and Proceedings of the Agri-Horticultural Society of India.

Scientific names to the vernacular ones are only given once, but a list of the vernaculars and their botanical equivalents is appended to the end of this paper.

The general working in bamboo may be learnt from Jagor's Reisen in den Philippinen, p. 36, with figures.

durable. However much depends upon the amount of silica, and those poorest in it are also the more perishable ones. In the Indian Archipelago the following kinds appeared to me to yield the more durable halms: bamboo bitoong (*Gigantochloa aspera*); b. andong bezar (*G. maxima*); b. atter (*G. atter*); b. hower (*Bambusa vulgaris*): while bamboo booloo (*Schizostachyum brachycladum*); b. awie? (*Sch. Blumei*); b. mayang (*Sch. longispiculatum*) and b. ietam (a variety of *G. atter*) are soon attacked by the boobook (*Bostrichus*). But Mr. Teysmann, whose long experience (over 35 years) in the Archipelago is a guarantee for the value of his observations, tells me that the following are quickly attacked by the boobook: bamboo atter, bitoong, wooloong (*Gig. robusta*); kriesik (*Schizo. Hasskarlianum*); lengka (*Giganto. nigrociliata*); booloo, andong kekeus (a variety of *Gig. maxima*); then follow bamboo ietam and b. dooree (*Bamb. Blumeana*). In return bamboo talie, b. andong bezar, b. hower and b. tootool (only a variety of hower) are those that last longest: although partly just the contrary of my own observations and those of Mr. Riggs of Jasinga (Buitenzorg, Java). On the Indian continent are chiefly used in house-building: behoor bans or Kya Katwa (*Bamb. arundinacea*); balkoobans (*Bamb. balcooa*); pao (*Dendrocalamus Hamiltonii*); kyattounwa (*B. polymorpha*); and kyellowa or wabo (*B. Brandisii*).

In the construction of bamboo-houses the halms of different sorts of bamboo come in use according to their greater or lesser strength, etc. Thus, for example, the Javanese uses by preference the halms (*battang, mal.*) of b. bitoong and b. andong for the principal posts and scaffolding, on account of their strength and greater durability, while those of b. atter and b. apoos (*Schizo. Blumei*) serve more for the construction of walls, etc., because the halms of these two latter species are of less thickness of wood and have no prominent nodes. For this purpose the halms are split into four or five strips, which are flattened out and firmly tied down with rattan or bamboo strings to the rafters; but more usually these broad strips are either lengthwise crossed over the rafters or crosswise laid one upon another in such a way as to give the wall the appearance of a huge chest-board (the alternating strips being usually coloured black and white).

Similar but broader strips are used for flooring, and in this case the halms are split on one side only, flattened out so as to form beautiful slabs from 1 to 1½ feet broad, while the sharp prominences inside the nodes are carefully removed with the parang or dah (wood-cutting knives). Such floors are delightful to walk upon barefooted, and still more so to sleep upon with a mat over them on account of their elasticity and undulating nature. The houses are covered with various materials, especially atap (*Nipa fruticans*) leaves, but often enough also with bamboo tiles (sirab mal.) or bamboo halms cut into two (called talapap mal.) laid on in the same way as our wooden ones. Smaller pieces serve for window blinds. Thin split bamboo tied up with silk form roll curtains for verandas, which permit the air to pass, but also agreeably temper the glaring light, especially if, as is usually the case, they are dyed green. Houses build in the manner, as Malays and Burmans do, are not only good looking and comfortable, but also healthy, and this the more so as they are raised above the ground. They are usually build for a single family only, but the Dayaks of Borneo, like the Naga hill-people and other tribes of the Eastern frontier of Bengal, like the Karens of Burma, build large communal houses often 200 to 300 feet long by 50 to 100 feet broad. These are divided into as many compartments as there are families, which often number up to 100. I have seen tays (this is the name by which the communal Karen houses or rather villages are known), which were as much as 30 feet raised from the ground, and when the people therein rushed to one side, the whole structure would hang over. One cannot look then upon the tay without thinking it in imminent danger of tumbling down, but the elasticity and strength of the numerous supporting bamboo halms effectually prevents any such accidents. The space under these houses usually is used as sheds for cattle, pigs, fowls, etc. Fishermen often build their houses solely of bamboo on bamboo (or palm) poles far out into the tidal rivers and sheltered bays of the sea, so that they stand in the water up to near the floor with every recurring tide. These resemble remarkably the ancient *pile houses* of the Switzer lakes, and are similarly connected amongst another by galleries. The greater part of the inhabitants of Bang-

kok (Siam) live in bamboo-houses build upon bamboo-rafters and let themselves float with ebb or tide downwards or upwards the river as they choose. The theatres in China are all made of bamboo, and so are the Chinese theatres in the Malay countries. Even in European house building bamboo has become quite indispensable all over India, and bamboo-scaffoldings are in general use in building the largest palaces and houses in Calcutta, etc., etc.

If temporary shelter is required, either by the native or the traveller in the jungles, nothing is so convenient as the bamboo, and how quick do they finish such a temporary house! A few hours' patience and the traveller is comfortably housed for the night, having not only shelter above him, but also his table, chair and bali-bali (bedstead) all made of bamboo. The leaves of the wild plantain or other large scitamineae usually form in this case the roofing material.

The younger halms of bamb. talie (so is called the not full-grown bamb. apoos) are cut into longer or shorter thin strips (talie-string) and serve for cordage. These strings, while fresh, are as firm and strong as ordinary cordage and used for every purpose: the bamboo-slips of the house-walls not only, but also the atap (leaves of *nipa* and *sagguerus, etc.*) and the bamboo tiles that form the roof, are fastened by their aid; loads, heavy or light, or smaller articles bound up in leaves, etc., are fastened with this same material; indeed they are used generally for all purposes for which in a civilized country a rope-maker is required. The aborigines of the Nicobars use the very long cane like halms of *Cinochloa andamanica* (very nearly allied to the Tjangkorreh of Java) instead of ropes, with which they fasten the large masts (a superstitious usage) that are erected in the sea before every larger village somewhat in the way as the masts of a European ship.

Bamboo-bridges are in general use all over India and Eastern Asia, however more so in the Indian Archipelago. Bamboo is admirably adapted for this purpose, although the people rarely bestow much labour upon the keep of these bridges, and thus they are soon decaying or carried off by the flood-waters. But the material is so plentiful at hand, and it is so quickly re-

placed, that it is more economical to use bamboo instead of more durable timber. Even in the Himalayas, where cane bridges are preferred, bamboo usually forms in so far part of these as one or a few bamboo-halms are laid on lengthwise and form thus the foot-hold in the structure. In Borneo and elsewhere such bridges consist merely of bamboo halms, crossing each other at the road-way like the letter X, and rising, sometimes on one side, sometimes on both, 3 or 4 feet above it. At the crossing they are firmly bound together, and to a horizontal bamboo, which forms the only foot-path, with another higher up, serving as a hand-rail. In Java, etc., bridges are build of this material over rivers 60 to 80 feet broad, with railings, cross-supports, etc., somewhat after the fashion of suspension-bridges, which look ornamental and deserve all admiration. Over such bridges not only men with loads, but even ponies and light carts pass safely. But also true pontoon-bridges are constructed on the same island, where the pontoons are substituted by strong bamboo-rafts, which rise and fall with rise and fall of the river or of the tides.

Along precipitous declivities in the hills bamboo-bridges and railings are not rarely constructed on the same principle as our engineers in Europe do the wooden ones, but here trees and roots are made use of for suspension. These bridges are traversed daily by men and women, carrying heavy loads, so that any insecurity is soon discovered and immediately repaired. When the path goes over very steep and slippery ground, the bamboo is used to form steps. Pieces are cut, about a yard long, and opposite notches being made at each end, holes are formed, through which pegs (also made of bamboo) are driven, and a ladder or staircase is produced with the greatest celerity. But ladders or substitutes for them are constructed in the most simple way for climbing lofty trees, especially for the purpose of gathering fruit or of obtaining bees wax. This, as Wallace tells us, is done by means of bamboo-pegs driven into the smooth stems of the trees. These pegs are made of old thick bamboo, split to about two inches wide. Each is cut above a joint, which forms a solid head to bear the blows of the mallet, and the point is flat and broad, cut away carefully to the siliceous

outer-coating. To the head of each is strongly tied a strip of the rough rind of a water plant. The climber carries forty or fifty of these pegs in a basket by his side, and has a wooden mallet suspended round his neck; he has also prepared a number of strong, but slender bamboos, each from 20 to 30 feet long. One of these he sticks firmly in the ground at the foot of the tree, and close to it; he then drives a peg as high as he can reach, and ties it firmly by the head to the bamboo; climbing up upon this, he drives in and ties 2 other pegs, each about 3 feet from the one below it, passing his arms between the tree and the bamboo, to hold the peg while he is driving in. He soon reaches the top of his pole, when another one is handed up to him, and being bound to the one below, he ascends in the same way another 20 feet. When his pegs are exhausted, a boy brings a fresh basket full up to him, and a long cord enables him to pull up the bamboos as he requires them. This mode of ascent looks perilous, but is in reality perfectly secure. Each peg holds as tightly as a spike nail, besides which the weight is always distributed over a great number of them by means of the vertical bamboos. Exactly the same mode of climbing trees prevails amongst the Nagas of Eastern Bengal (see Peal, a visit to the Naga Hills; Journ. As. Soc., Beng., 1872, part 1, t. 5, left hand), and similarly amongst the Karens of Burma.

Bamboo-halms are also well adapted for aqueducts of a primary nature. The largest kinds of bamboo are taken for this purpose and split in half, supported on crossed poles of various height according to requirement. Also water-pipes are often made by simply perforating internally the solid nodes.

Although bamboo generally is not fit for the construction of boats or canoes, Chr. Costa tells us of a sort of bamboo in the Moluccos (most probably *Gig. maxima*), which produces such thick halms, that the single joints split in halves are used for little canoes, in which two men are said to find place! For masts and spars of small native vessels bamboo is in general use. The outriggers of canoes peculiar to the Phillipines and Ceylon are all of bamboo. The Nicobarese, who use similar outriggers, make them of light wood, because bamboo is, strangely to say, rare with them. The other parts of a boat, such as

cabins, etc., are usually constructed of bamboo on the same principle as houses. Bamboo is in use for rafts all over India and the Archipelago. These are simple or more usually doubled up, and in the latter case often furnished with ornamental railings. The construction of such a raft (including the cutting of the bamboo in the jungle) takes usually between 1 to 1½ hours time if done by men expert in such work. They may carry even a pony over deep waters. For floating of timber bamboo has become also highly important to the forester. For this purpose, of course, size and still more the hollowness of the halms are the principal requisites. Hence in the Archipelago bamb. apoos, b. andong, b. atter and others are useful, and in Burma chiefly waya (*Bambusa longispatha*); tin-wa (*Cephalostachyum pergracile*), wabo or kyellowa (*Bamb. Brandisii*). In Sikkim it is the pao (*Dendrocalamus Hamiltonii*) chiefly that is used for this purpose.

Several sorts of bamboo form good living hedges and are in this regard far superior to the artificial ones on account of their durability. The unarmed small species, especially the so-called China-bamboo (bamboo cheena, mal; Wa-pooloo-Pinang, Burm; *Bamb. nana*) is generally used in the Malay countries and southern parts of India. For hedges intended to prevent the entering of cattle or man, no other bamboo or material is more adapted for the purpose than behoor bans; or, as the Burmese call it, kyakatwa, while in the Archipelago the very similar bamboo tyoo-tyook (*Bamb. Blumeana*) is still more effective, and forms much denser and impenetrable fences. How easily such hedges may be raised may readily be understood when I mention, that bamboo joints (with nodes on them), put in hedge-row take roots as readily as willows, and grow as rapidly if planted out just after the rains have set in or during the rainy season itself, but when done so in the dry season frequent watering is not always accompanied with success. By trimming, the bamboo hedges can be kept low.

But there is another application of bamboo which seems to be peculiar to the Malayan people, *viz.*, they use bamboo for the construction of triumphal arches and posts. No one who has not seen them can fairly appreciate the skill and taste display-

ed by the Javanese in this sort of work. Yesterday you saw nothing but a heap of fresh-cut bamboo-halms, and to-day these rude bamboo-poles gradually become converted into arches, gates, and structures of the most exquisite patterns. The principal arch with lateral ones, all formed of 4 to 6 cornered columns filled out with skillfully wreathed trellis-work, soon shew the style of workmanship, and, after the skeleton is thus formed, broad and thin-shaven strips of bamboo and the soft yellow sheaths of the plantain-leaves, taken from the interior layers of the trunk, are folded into artificial stars, flowers or mashes, and ornamentally arranged on the archings and columns. To these are also added guirlands (of bamboo material) intermingled with natural flowers which gracefully hang down according to tasteful designs. A few bouquets of natural and gorgeous flowers often are added as a finish.

The furniture of the Malays, Burmans and those people that live in tracts of India where bamboo abounds, is made chiefly of bamboo. Table, chair, waving-chairs, bench and other household articles down to the drinking cup are all made of bamboo. The greater portion of a bedstead is entirely of bamboo of different sizes, joined together by means of bamboo-pegs and bamboo-strings. Mattrasses, cushions and pillows are often stuffed with bamboo-shavings, although the cotton of *Bombax* and *Gossampinus* are more generally in use for this purpose. The bamboo-halms, says Rumphius, are in daily use for fetching water from the river. The longest joints of the greater sorts of bamboo [such as b. andong, b. atter, b. wooloo, b. apoos, or in Burma waboor, kyellowa, waya, teiwa (*Bamb. Tulda*) and kyatrounwa; in Sikkim chiefly pao] are taken with both knots left on them, in one of which is cut a small hole through which the water is poured in and the hole is then closed with bamboo or more usually plantain-leaves. Such water-holding joints are called kélé by the Sundanese, and gunych in Malay. It is also the custom with these people to have bamboo-poles of two or three joints, of which the uppermost and median knots are perforated, and filled with water; such are called lodong in Malay. The women and girls can daily be seen, with such water-tubes on their shoulders or (like the Karens) having them sus-

pended by bamboo-strips from their forehead, going down to the wells or river, where they fill these tubes with water for the use of the coming day. The water keeps very well in these bamboo tubes without taking any tang if the holes are well closed. A dozen or so of these bamboo tubes stand usually in the corner of every Malay house, serving not only for cooking and drinking, but in time of need for extinguishing fire. In climbing high hills, or when travelling through tracts poor in water, the drinking water is carried in similar water-pipes. Rice, vegetables, coffee, tea and other food is cooked in similar tubes taken from young, and therefore somewhat succulent halms. Food thus prepared partakes of a particular tang, (that of burnt fresh vegetables), but it is never refused by a hungry stomach. Single joints of bamboo andong, and also of the Sikkim pao, serve also well for small water buckets. Thinner halm joints are cut just below the nodes, and the Indian obtains in this way little tubes, solid below, in which he keeps fluids, honey, sugar, salted fish or fruit just in the same way as we do in bottles or jars. Many a Javanese can be seen on market days carrying home in this tube, suspended from bamboo strings, the oil, etc, that he wants in his little household.

Chinese masons use for white-washing brushes made of thin bamboo slips fastened together and secured in a handle of bamboo. The Malay has similar ones, but beats with a mallet the whole end of a bamboo joint until dissolved into fibres. However pandan air roots are with him much more in use for this purpose, as they can be beaten more easily into brushes. The small brushes, used in China for colouring pictures, are also made of fine bamboo shavings introduced into a small holder of bamboo. Modellers of the same country use small chisels cut from the hardest part of the bamboo halms, and they are very expert in the use of them for carving plaster and such like soft material.

Also candlesticks are made of bamboo, and I confess they are superior to those that European travellers often take refuge to, *viz.*, empty bottles. They select for this purpose thin bamboo joints, whose hollowness is wide enough to receive a candle, leave the node about the middle and cut the portion

below this node into threes. A stone between these three segments is secured to them by means of bamboo strings and cross sticks, and so the whole furnishes a tripod candlestick, which is less liable of being upset down than the bottle candlestick.

Bamboo enters also the list of the many contrivances by which fire is obtained by Indians. For this purpose quite dry bamboo joints of 2 to 3 feet length are split into twos. The one half of these is furnished in the centre with a longitudinal slit. The interior of the joint is shaved, and the shavings put inside the longitudinal slit and pressed against it by another piece of bamboo. A longer slab of bamboo, sharpened at one side like a knife, is now rapidly and tightly crossed (like a saw) over the hole from which the bamboo shavings protrude and soon ignites them. This mode of obtaining fire is preferable to the many other contrivances in vogue with natives, care being taken that all the material be perfectly dry, and, therefore, old dead bamboo is usually selected for the purpose. Boyle met even pneumatic fire implements of bamboo with the Dayaks in Borneo.

But the ingenuity of the Indian does not end here, for bamboo is used also for making knives. One side (the outer coating of the halm) of a flattened bamboo slab is sharpened, and, owing to the great amount of silica it contains, grass and low shrubbery can be mowed down quite well. Small ones, made on the same principle, are used by the Javanese even for the operation of circumcision of their children. Broader slips of bamboo, especially of those kinds that are very rich in silica, serve as whet stones, the surface being used for this purpose. In small pointed pieces they serve for pegs, and still smaller and thinner even for pins (like the spines of rattans) to the great disappointment and disgust of many a zealous entomologist.

The use of bamboo for pikolan (carrying poles) is general amongst Malays, and even children are fond of appending their load (and were it only a few plantains) to a bamboo stick for the purpose of "pikol," as this mode of carrying is generally called. The bamboo halms are very strong, and can resist loads of 100 to 200 and even more pounds, but if exposed too much to the sun they are apt to crack on account of the heating of the air enclosed in their joints. Smaller pikolans are made

of a shape somewhat like bows, flattened and the edges rounded. These are often more or less ornamentally carved towards their ends. Loads of equal weight are fastened at both ends so as to keep the balance. When a Javanese has only to one side a load which he cannot divide, he appends as much weight (and were it only a stone) to the opposite end; so innate is custom in man. The carrying of such loads has its peculiarities, inasmuch as the carrier hastens in a short pat in consonance with the elastic swingings of the bamboo, taking at the same time advantage of every swing that may lessen his burden. In this way he carries with less exertion a larger load than do the monotonously singing palkee bearers of Bengal, whose poles consist of unelastic wood.* For tent poles the bamboo halms are excellent and generally in use all over India. Sedan-chairs are extensively used in China, and the ordinary ones are entirely constructed of pieces of bamboo fitted together, while two long bamboo poles pass under the chair and project beyond it before and behind. Batons for certain classes of mandarins, too, are of bamboo, as also the well-known chopsticks of the poorer classes in China.

Bamboo is also fitted for yokes of cattle, axles and even springs of the smaller carts. In Java, etc., these carts have a sort of a little bamboo house build upon them with a sort of vestibulum in front, wherein the driver comfortably sits, and often falls asleep without knowing it.

If we have in Europe ugly scarecrows and such like for driving away the flocks of depredatory birds from the young sowings and cornfields, so has the Malay also his own invention for the same purpose. This consists usually of long bamboo halms, at the end of which is fixed a wind wheel (also of bamboo) which is moved by the slightest breeze with an ugly rattling noise which scares away the numerous rice thieves, a small finch called booroong klatten (*Fringilla oryzivora*, L.) and the numerous small parrots that swarm on the ripe rice-fields. This noise is very disagreeable to the ear, and continuously interrupts the stillness of tropical nature. The Javanese often places in various parts of his field numerous

* Mr. Karz overlooks here, that the bearer effects the reduction of pressure during the upward swing of the bamboo by an increased pressure during the downward swing.—The EDITOR.

bamboo sticks of this description, from which are suspended pieces of cloth and other light articles, and connects all these sticks with a bamboo or rattan string. The man who keeps the end of this string, in his hand, pulls them from time to time for the same purpose as above. In such cases he almost invariably erects little bamboo houses on high posts in which he is concealed like a spider, keeping the strings in his hand.

Bamboo loops for weeding (see Peal, Journ. As. Soc. Beng., 1872, Pt. I., t. 4. 4) are used by the Nagas as well as by the Malays.

Bamboo joints of the larger bamboos are also used for beehives (see Junghuhn, Java I, p. 180, and Scherzer, Reise der Novara, II. p. 155) For this purpose a closed bamboo joint is used, or more frequently this joint is cut into twos and again tied together by means of strings and horizontally suspended under the roof of the house. A small hole made at one end of it enables the bee (*Melipona minuta*) to enter these hives. It is a very small and harmless bee, but produces handsome wax, used chiefly in coating the figures in sarongs for dyeing purposes.

While the rich have ivory and costly fans, those of the poorer classes are made of slips of bamboo covered with paper adorned with fantastic designs and vivid colours. Hand screens as well as standing ones are made of the same material, similarly constructed and furnished with ornamented paper or silk. The handles and frame work of the Chinese sun and rain umbrellas (payong) are also made of bamboo, and used not only in Japan, China and the Malay Archipelago but also all over Indo-China as far west as Burma.

For walking sticks are the Malayan and Indian bamboos less in use than the Japanese ones, and are derived chiefly from various species of *Arundinarias*. The Japanese pepper canes are well known and come from a species of *Phyllostachys*. These of *Phyllost. nigra* are very elegant and smooth, but have, like a few others of the small kinds of bamboo, their joints alternately semi-terete. Another kind, (sikak take Jap.) botanically apparently not yet known, is mentioned by V. Siebold (who enumerates not less than 33 varieties of Japanese bamboos in the Verhand. Batav. Genootsch. der Kunsten en Wetensch, XII., p. 4-6), which has square halms. Of this M. Ed. Renard gives an account in

the March No. of the Bulletin de la Societè d' Acclimatisation. M. Renard says he met with this bamboo only in the beautiful plains surrounding the large town of Osaka in Japan. It naturally forms a square halm, but the angles are not very sharp. It grows to 30 to 40 feet in height and differs from all the other Japanese bamboos in not having a polished surface to the halms. The joints are rather short and the nodes prominent. It is chiefly cultivated for its ornamental appearance, and the straight halms are used as walking sticks, the root-part being fantastically carved. The thin and very strong lateral branches of bamb. hower and its varieties make handsome pipes. Malays will construct huge hookahs in a few minutes by inserting a small bamboo tube for a bowl, at a sharp angle, into a large cylinder, about 6 inches from the bottom, which contains water through which the smoke passes. Smaller pipes of the ordinary pattern are as easily and quickly made, and often used even by the European soldier in India.

In a small bamboo-box, prettily carved and ornamented, the Dayak of Borneo carries his siriñ and lime, which he uses in betel-chewing.

The Chinese have games of dominoes almost exactly like ours. They are formed of small pieces of cut bamboo, arranged, glued together; one of the pieces is painted and shews the numbers in black and red. Toys for children are generally made of bamboo, such as long bamboo-sticks terminated by a wind-wheel which are carried against the wind, also smaller sticks on which are put flowers made of fine bamboo-shavings variously coloured, and even articulated bojazzis, coloured and moved by strings, can be seen amongst these native toys. Cages, often very ornamental, for birds, etc., and large ones for tigers, etc., are also made entirely of bamboo. Weaving shuttles of bamboo, and rakes made of a cross bamboo-pole with handle to which the bamboo-teeth are obliquely inserted, are things of daily use.

The sheaths in which the Malay carries his long-bladed knive (parang) are of bamboo, and often carved. The cigar-etuis made of the halms of bamb. booloo koneng (*Schizo. brachycladum*, var.) of a beautiful golden-yellow colour are greatly esteemed in

Java. Weirs and fish traps, as well as fish-rodes of bamboo, are used everywhere.

Split and shaved thin bamboo is the strongest material for baskets, and excellent baskets, boxes, conical fish-traps, hencoops, etc., are made of it. For fishery purposes are thin halmed species of bamboo in use, and one sort, *viz.*, booloo seroo, has got its name on account of its fitness for this purpose. Large bamboo-mats of various qualities are sometimes made by the Malays, while the sacs for exporting sugar from Java (called kranyangs) are usually made of bamb. doorie (*Bamb. Blumeana*). The large hats, called toodoongs, which the Javanese men and women wear, and which resemble more the half of a huge pumpkin, are a close network of thin strips of bamboo, coloured and varnished all over the outer surface. The shalako, or head-dress which Europeans wear at Saigoon (Cochin China) is likewise made of bamboo. The Bugginese and Macassers of Celebes make also very fine delicately woven caps of bamboo. The Chinese go so far as to make jackets of the lateral branchlets of a small sort of bamboo. These are about as thick as a crow's quill, and are cut into small pieces about ½ inch long, bound at intervals in rows along a silk-thread and connected into square meshes. Chinese dandies like to wear such bamboo-jackets on their person in order to protect their white cotton-dresses of sweat. Like in the Malay countries so in Burma, boxes of a peculiar kind are made of tight bamboo-network, which are lacquered all over and usually coloured red. In these not only substances, but also fluids can be kept safely. Small boxes of this sort generally serve as sirih-boxes, and at the same time also for drinking cups. Those from Palembang are covered with a varnish so elastic that they can be turn d inside outwards without causing cracks or being damaged. The natives of Behar employ the jungli bans (*Dendrocalamus strictus*) for making neatly-worked plates, hand fans, etc., which are generally sold in the towns through the whole of India.

Bamboo greatly enters into native music, especially in the Indian Archipelago and China. In every bamboo bush, says Jagor, are hidden the musical instruments for a whole orchester! A sort of Æolian harp is represented by the so-called plaintive

or weeping bamboo (booloo perindoo or booloo menangies). Sir Emerson Tennant chronicles this sort of natural music thus: In the Malayan Peninsula (but also all over the Archipelago, etc.) the living bamboo has been converted into an instrument of natural music, by perforating it with holes, through which the wind is permitted to sigh in the most charming manner. Mr. Logan, in 1847, in approaching the villages of Kandingoo, heard sounds, some soft and liquid like the notes of a flute, and others deep and full, like the tones of an organ. On drawing near to a clump of trees, a slender bamboo, 40 feet in height, was observed; and it was ascertained that the musical tones issued from it, and were caused by the breeze passing through the perforations in the halm. Those which Mr. Logan saw had a slit in each joint, so that each halm possessed 14 to 20 notes. Living bamboo is often similarly perforated. One of the former Governor-Generals of Dutch India (Baron van der Sloet) used to have a large number of these plaintive bamboos near his palace in the centre of the Botanical Gardens at Buitenzorg, Java. Flutes and fifes are easily made of bamboo on account of the hollowness of the halms. The Chinese have two kinds of bamboo flutes. One kind is closed at one extremity, either by a natural knot or by a stopper of bamboo shavings; along this flute holes are spaced out at regular distances, the first being the mouth piece, and the others being opened and shut by the fingers of the player. Another flute resembles the foregoing, but the knot at one end is cut to a slope, and an opening effected as in the flageolet. There is also a kind of Chinese violin called the hyi iëng, and an ugly thing it is. It consists of a 3 to 4 inch long and 2 inch thick bamboo joint closed at its extremity by a tightly stretched snake's skin. To this is inserted a bamboo-handle about 2 feet long, to the upper end of which are fixed the 2 strings resting on a bridge on the snake's skin. A piece of split bamboo is used as a bow. The Jakoons in Malacca make also a sort of guitarre consisting of a bamboo-tube about a foot long, on which are lengthwise strained 3 or 4 strings which rest on small pieces of wax instead of the bridge. A kind of very curious whistle is used by the Chinese for driving away evil spirits, etc. Several holes are pierced in

a piece of bamboo, two of the natural knots being left, one of which offers an opening out in a slope; to each extremity are fastened 2 long strips of paper from 15 to 18 feet in length and 6 to 8 inches wide. A string is attached to a groove made in the bamboo, and when there is a little wind, this curious kite is sent aloft, remaining in the air as long as the wind is strong enough to keep it up. In this position a monotonous whistling is produced, resembling at times the noise of a jet of steam, sometimes the sighing of the wind in trees. The anklong of the Malays is a very agreeable instrument. It consists of a number of hollow bamboo-joints of various but selected length and thickness which are cut out below and hang down from a bamboo-frame. These give various swinging tones and strength, according lead to their size on being beaten with a bamboo-staff. On the occasion of festivities, such as marriages, circumcision, etc., Malays greatly use the green halms of bamboo (especially the larger sorts), and have them put in specially prepared fires. The air enclosed in the joints gets heated, and the joints burst with a heavy report, which varies in strength from that of a pistol to that of a small gun according to the sort of bamboo used—smaller halms being usually added which keep up a continuous rattling and crackling noise.

Some attention has been paid of late to the bamboo as a textile plant. A fibre has been obtained from the halms suitable for mixing with wool, cotton, and even silk. It is said to be very soft, and to take dyes very readily. To prepare it, the stems are cut across at the joints, and boiled in caustic soda for a lengthened period. The liquid is then drawn off, the halms washed in fresh water, and again boiled in a solution of caustic soda until the fibre of the halms has become somewhat soft. The halms are next put between heavy rollers and crushed, and finally carded or combed, after which it is made up into bales for exportation. When we consider the lengthened period and apparently complex process of its preparation, the question naturally arises whether it can be produced in sufficient quantities and at a sufficiently low price to be remunerative. Mr. Teysman, during his travels on the Moluccas, has observed that the women of those islands chew the young halms of bamboo booloo (*Schi-*

zost. brachycladum) so long until only the fibres remain, of which they weave coarse cloth, bags, and sacs.

Bamboo is in China the principal, if not only, material for paper-making, and was there used as such when our forefathers were still savages hunting the vast forests of Europe. Cut when quite green, it is scraped and cleaned; the thicker shavings are used for stuffing mattrasses and pillows; the finer shavings are macerated in water and reduced to a paste by a special process. This paste is mixed with a certain proportion of isinglass, and sheets of various qualities of paper are manufactured. The unbleached paper is slightly yellowish, but smooth, soft, and of great strength. The shavings of inferior quality are also macerated, converted into paste, then made into sheets and dried. It is mixed with slaked lime to form a substance with which walls are plastered. This bamboo-paper is also made use of to produce a kind of tinder, very much in request with the lower classes in China, especially the watermen. For this purpose paper rolls are lighted, and as soon as the ignition is complete, the burning rol is thrust in a small bamboo tube, which is immediately closed and the flame thus suppressed. When fire is wanted, the burnt end of the paper is kindled by means of flint and steel and the paper burns like ordinary tinder. Blowing on this sharply, once or twice, is sufficient to raise a flame—a result that cannot be obtained with any other kind of tinder.

For defensive works serve especially bamboo dooree (*Bambusa Blumeana)*, a species very similar to the behor bans (*Bambusa arundinacea*). It forms an impenetrable fence on account of its numerous dependent branchlets armed with copious recurved sharp thorns (spiny buds), and such fences are very generally planted round and in the trenches of the Malay fortifications and redoutes. These fences form in war serious obstacles to advancing troops, and have been recognised as such by the Dutch military men who employ at present the same instead of pallisades; for they prove more durable, really quite impenetrable, and against which even European artillery can do little. The same sort of bamboo is also extensively employed for fences round villages in tracts where tigers are uncomfortably numerous. The so-called rangyoos are thin bamboo pegs sharpened at both ends

which are put in oil and slightly burnt in fire. Such pegs are put vertically in the ground hid in grass. They cause very dangerous wounds, and, in wet weather, can penetrate also the moistened soles of shoes. In the campaign of the Dutch against the Boogginese of Boni (Celebes) in 1859, the Dutch soldiers all carried bundles of such rangyoos, but the Boogginese were not such fools as to run into them, nor hadt he Boogginese rangyoos any effect upon the Dutch troops. Similar bamboo-pegs, prepared in the same way, are used in time of war by all the Malayan tribes and also by the hill-people of Assam and Burma. Against cavalry similar, but much larger, and more solid rangyoos are employed, either placed singly and obliquely in the ground amongst high grass, or more usually crosswise and tied with strings forming thus the so-called spanish riders or chevaux-de-frise. It is a very common custom with Malays and Burmans to place strong bamboo-poles across paths in long grass or dense jungle, fixing them firmly at the one end while the bamboo is tightly strained and fastened at the other end in such a way that it immediately unbuckles as one steps on it or only unceauriously touches the pole, thus striking with all force against the legs of the passers by or the passing enemy. The people of Arracan and Tenasserim have, for catching tigers, a similar method. The bamboo-pole is then vertically planted in the ground and strained downwards by means of a strong rope terminating in a large noose arranged so that the tiger, which preys upon a bait laid for him, must pass and touch the noose, when, of course, he is at once launched into eternity. Blow-pipes (sumpitan, mal,) consist usually of 2 bamboo-tubes of 7 feet length by ¾ inch broad, stuck one into the other. The inner opening is about ½ an inch in diameter. The arrows, ussually 7 inch long, are made of various material, chiefly of the nerves of palm-leaves, wood, or the halms of coarse grasses, rarely of bamboo, and poisoned: they are kept in bamboo-quivers. Most of the savages and independent tribes of tropical Asia still use spears, the shafts of which are of bamboo, javelins, etc. In Java they use for catching thieves, a curious instrument. It consists of two bundles, as thick as an arm, of the lateral thorny branches of the bamboo doorce, which are fastened

fork-like at the end of a bamboo-pole; with this fork they try to catch the person from behind at the neck. As the thorns are all reversed the captive cannot easily escape. In every watch-house along the roads and in the villages of Java this sort of instrument is in general use, and the Javanese are very expert in its use.

The uses of bamboo, however, are not only restricted to technical purposes, but bamboo furnishes also a share in Indian cookery. The young shoots (called rebong in Malay) just when they burst from the ground like gigantic scaly horns, are a favourite vegetable with the Malay and Chinese. Most of the larger sorts, as bamboo bitoong, wooloong, andong, atter and more especially b. kriessik, yield edible rebong, while those of the small kinds are used little, being often are of a bitter taste and therefore not edible. These rebongs are cleaned of the sheaths and of the numerous stiff hairs (which act irritating upon the skin,) cut into small pieces, and, with other additions and seasoning, form a well-known Malay vegetable (sayor rebong). Pickled they form the atsyar, which is frequently exported. In China are also used the shoots of the smaller sorts, while about 6 to 7 inches long and as thick as one's finger. They are of a very fine light yellow colour, are very tender, and but slightly stringy. Sometimes they are boiled in water, a little salt being added, and resemble then asparagus. They are eaten not only by the Chinese, but also by foreigners sometimes with oil, or with white sauce, or cut in small pieces as salad, or more usually made into the more liked "poison gratiné au bambou." A more important rôle play the seeds of several species of bamboo (usually called by the natives "bamboo-rice") in years of scarcity in India. These resemble somewhat oat-grains, and the yield of a stock of bamboo is enormous. At the same time there is a remarkable tendency in bamboo to flower and fruit in unusually hot and dry seasons when famine and scarcity are the usual concomitants. The seed contained in the hard fleshy pericarp of *Beesha baccifera*, the "berry" bearing bamboo, is a pleasant eating, being not at all austere, though without much flavour. The Arracanese declare also the pericarp edible after baking. The leaves are much in use as fodder for cattle in regions where

meadows or o her grass are scarce or wanting as in the Sikkim Himalaya. Such was the case for a long time on the Andamans, where pastures are entirely wanting. The young shoots, like the plantain stems, are a most favourite food of the elephants.

In native pharmacopœa we find the water, which often accumulates in the bamboo-joints, especially of very hollow kinds, used against bowel-complaints, with what success I cannot say, but all I can add is that this water in the bamboo halms, like that found in the pitchers of the *Nepenthes*, has often quenched my thirst during my tours in the Java hills. Numerous other medicinal virtues are ascribed to various parts of the bamboo by Loureiro (Flora of Cochin China), and by Father Blanco, in his Flora de Filipinas, but hardly worth mentioning here. The stiff fragile very fugaceous hairs or rather bristles on the sheaths of the shoots are used for poisoning. They are put in the meal, or more usually in the coffee to be partaken, and are said to cause death, not suddenly, but the action is very slow and the victim succumbs only after many months. Tabasheer is a siliceous whitish floury substance which is found as a secretion, or more probably as a residuum in the interior of the joints of several species (especially *Bambusa arundinacea*) often up to an inch in thickness. It is employed in Western India to cure paralytic complaints, and as a stimulant and aphrodisiac. In China, it plays a great rôle in Chinese medicine, and pretty large quantities of tabasheer are exported especially from India to that country and Arabia. Tabasheer is also used in polishing, a quality it owes to its silicious composition.

Noteworthy is the great amount of silica of most of the species of bamboo, which is so great that the ash of burnt bamboo-halms shews distinctly the silica-skeleton of the structure. This amount of silica, however, varies greatly in one and the same species, as for example in bamboo tamyang of which the one of its varieties (bamboo tamyang sonoh) turns so hard that sparks are emitted from the halms when cut with the parang.

For religious purposes, the bamboo furnishes in the Philippines churches, chapels and crosses. For educational purposes,

says F. Jagor, is the rattan far more in vogue, and is vigorously resorted to, so much so that a Philippine proverb says: There sprout a thousand rattans in the jungles for every Indian born. The Chinese cut fantastically-shaped figures from the knobby rhizomes for their temples and house-altars. The peculiar throw-pieces, used in the Chinese temples for auguring the success or failure of an undertaking according to the nature of the fall, are also made of bamboo.

For ornamental purposes and landscape gardening, bamboo forms one of the most picturesque features, of which especially the Chinese understand to make full display of it in their rockeries, etc. This effect is still more enhanced by the gaudy glossy colouring of the halms of many species, and the varieties of bamboo bower and leleba, as well as those of boolooo along with the black-stemmed species of Phyllostachys of China and Japan, are more especially noteworthy in this respect, and ought sooner or latter come into general use in the South European gardens. Indeed in Italy bamboo is already much in cultivation in the open air, but the night frosts and occasional snow falls will always form a great obstacle in their open air culture in Europe. Mr. E. B. Fenzi of Florence has given notes in the *Gardener's Chronicle* for 1872, pp. 1228—1229, on the species (or rather varieties, some of which are however enumerated twice under other garden names) that are cultivated and hardy in Italy.

I may now conclude with alluding to a fearful penal punishment, formerly in use in Bali, for the publication of which Dr. F. Jagor must be made responsible. He tells us that the criminal was strained horizontally over the young growing shoots of a bamboo stock, of which the longer halms have been removed. As these grow very rapidly the very hard silica-rich (?) shoots pierce through the unfortunate sufferer.

This resumé of the uses of bamboo, although still meagre, may yet remove any surprise on our side when reading in Rumphius' Amboinsche Kruidboek, IV., p. 13, that the Radjahs of Boutan (Moluccos) were proud in asserting that their forefathers sprung from the womb of a bamboo.

II.—General habit and growth of Bamboo.

However great the number of the species of bamboo may be, they all agree in general habit, so much so that one rarely can confound them with other plants. Those majestic forms that grow up to a height of 90 to 120 and even more feet, impress the mind of the new comer as much as the palms and plantains, and where they associate into forests they usurp the whole terrain and expel all other plant forms; they form a highly homogeneous physiognomy, but still agreeably influence the human mind. They equally combine vigour and elegance and almost always form a strong but attractive contrast with the surrounding vegetation. The distichously branched halms rise, like gigantic plumes, to a great height, lovely bowing outwards in graceful arcs towards their ends. The stiff and rigid halms, moved by the wind, impatiently rattle and melancholically sigh, while the dry harsh foliage rustles through the forest. Between the majestic old colossal columns of bamboo, one wanders through these dark arcs often hindered in the progress by fallen or rotten halms. In these vaults a peculiar uneasy twilight prevails, and one cannot dismiss the thought that the whole forms a natural Gothic church. Nothing is more impressive and melancholically beautiful than a cemetery in a bamboo-grove, as one can verify for himself in visiting the cemetery of the Governor-Generals in the Botanical Gardens at Buitenzorg, Java.

Such is the general impression that larger bamboos effect upon the mind of man, but there are gradations, and as we go northwards and enter the more temperate zones of our globe we meet with smaller and smaller kinds, until they dwindle down to mere undershrubs, when they little differ in aspect from other grasses.

Most, if not all, bamboos, are eminently gregarious and form jungles for themselves, or the undergrowth of high forests. If individuals occur also singly or few together, they are strayones, and their species will be found in one or the other locality in quantity.

The bamboo, full-grown, forms usually a more or less developed stock, sometimes up to 3 feet high, formed chiefly of old

trunks of the dead halms and an entanglement of roots, from which 10 to 50, and even up to 100, halms arise of the thickness of one's arm to that of a human thigh, often attaining upwards of 120 feet in height. There grows also a species in Tenasserim of which the halms are said to grow singly from the stock, and which for this reason is called tabein-dein-wa.

The halms are branchless or furnished only with small very inconspicuous branchlets, either up to ⅔ of their whole length, and then they possess a columnar appearance (bamboo wooloong, bitoong, andong, atter) or they are furnished already from the base or from the middle with whorls of branches arising alternately or rarely (mostly only abnormally) in an ⅓ arrangement; also in this case the halms are still well visible, as for example in bamboo hower, booloo, etc. Most species of *Schizostachyum* are characterized by the crowdedly placed halms of only one to a few inches thickness, which become quite hidden from view on account of the numerous drooping branches, and hence they resemble from a distance more to gigantic hemispherical shrubs. Low shrubby species are rare within the tropics, and I know only of two, *viz.*, the lelebas of the Moluccos, and booloo akkar (*Schizost. chilianthum*), a Sumatran species. On the other hand, by far the greater part of the *Arundinarias* (which all possess only 3 stamens) are shrubby and restricted to the higher regions from about 5,000 feet upwards, while in higher latitudes, in China, Japan and the Kuriles, they descend to the plains and differ not in espect from other grasses. Of truly scandent bamboos I may mention the few species of *Dinochloa*, of which tjangkorreh of the Archipelago climbs into the loftiest trees up to 100 feet, and wa-nway (*Dinochloa Maclellandii* and *D. Andamanica*) are not less lofty, often hanging down with their ends from the loftiest trees in numerous festoons. The species of *Pseudostachyum* are half scandent and arching bamboos.

The shoots, which protrude from the earth at the beginning and during the period of the rainy season, and especially the sheaths that cover them, furnish the best distinguishing marks of nearly allied species when out of flower; these marks are most constant in the same state of development, and hence are invariably relied upon by natives, not only of the Malay countries

but also of India generally. These shoots first appear as scaly cones, or to speak with Rumphius, as curved horns (rebong, mal.; gora, Beng.—see plate I., fig. 1), and in this state they are fleshy and often edible when cooked. They are quite covered with imbricating sheaths, variously clothed with stiff fragile deciduous bristles which easily penetrate the skin and cause much irritation. Further developed, when the joints of the halms become visible, they are called siroong by the Malays, and it is in this stage of development that the differential characters are most conspicuous and can be studied to the best advantage. The sheaths attain their fullest development, and consist now of the sheath itself, the imperfect blade (corresponding to the leaf of the developed plant), the auricles which are usually only the decurrent often thickened base of the imperfect blade continuous with it, or these auricles are rarely not developed at all, and finally the ligule, a membraneous, broader or narrower, entire or fringed membrane which inside fringes the junction of the sheath with the imperfect blade. All these parts, as already noted, are of special importance, and variation of the same takes place only within certain limits of the species itself, and more especially with reference of the development of the sheath; all matters which must be studied in nature, and which, once recognised, greatly facilitate the recognition of bamboo species. In some species of *Phyllostachys* (*Ph. nigra*) the shoots creep as rhizomes a long way under the ground before their ends come to day, and at the same time they send out lateral shoots from their joints at certain distances which similarly burst from the ground, and finally grow out into dense shrubs. This species, therefore, covers in a short time large areas by this process, and it is often difficult to check its spread.

The sheaths, with which the branch-shoots are protected, generally agree in shape and indument with those of the halm-shoots, and more especially in the imperfect blade, but are very differently shaped amongst themselves according to whether they are taken from the lower or upper parts; hence they are less recommendable for the discrimination of species, although they may serve as such in the absence of halm-shoots.

The rapidity of growth of bamboo-shoots has been com-

mented upon by several observers. The mean period of growth of bamboo-shoots, during which they attain their full height (30 to 90 and even 120 feet) but not their development into branch whorls, etc., oscillates between 2 and 3 months. Until they have reached their full height large developed leaves appear only on the extremities, and it is only at the period when induration or rather silification of the still soft halms begins that the development of lateral branches fully takes place, commencing in most species from below upwards.

Much has been written about the rapidity of growth, and more especially regarding that of bamboo grown in European stoves. Thus in the hothouse of the Botanical Gardens at Glasgow it has been ascertained to rise one foot in 24 hours. Inspecteur Bouché of the Botanical Gardens at Berlin measured a bamboo (said to be *B. verticillata*) from the 24th June to the beginning of October, and gives 38 feet as the height reached. From 28th June to 4th August it was daily measured, and grew 10 feet in 38 days, thus 3½ inches per day, but during some very warm days 7 and even 9 inches. Several other notes on this subject may be found in the pages of the *Gardener's Chronicle*.

However, we have to do here chiefly with the growth of bamboo in their native state, and I regret to say that the measurements at our disposal are not so satisfactorily as they should be. I give here the accounts of them as far as I am acquainted with them, letting follow my own measurements which I made many years ago.

The first measurements of the growth of bamboo-shoots were made by a native Mohamedan gardener, Mooty-Oollah, under the superintendence of Dr. Wallich, in the Botanical Gardens at Calcutta, and communicated by the latter to Prof. V. Martius.* They are not accompanied by any data of temperature or weather or anatomical researches, but still interesting as far as they go.

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* V. Martius Ueber das Laengenwachsthum der Bambu-Schoesslinge. (Bulletin of the Roy. Academy of Sciences of Munich, No. 33, May 12th, 1848.)

Increase in length in English inches.

DATE.	BAMBUSA GIGANTEA, WALL.		BAMBUSA BALCOOA, ROXB.	
1833. July.	Morning.	Evening.	Morning.	Evening.
1	3·00	3·25		
2	3·00	3·50		
3	4·00	4·50		
4	4·00	3·00		
5	5·00	3·50		
6	4·00	3·50		
7	4·50	3·50		
8	4·50	6·00		
9	4·00	5·50	1·25	1·00
10	3·50	6·00	1·50	1·25
11	5·00	5·50	1·50	1·25
12	5·00	6·00	1·50	1·75
13	5·00	5·00	2·00	2·25
14	5·50	4·50	2·50	2·75
15	4·50	5·00	2·25	2·75
16	5·50	5·50	3·00	3·00
17	5·50	5·50	3·25	3·00
18	5·50	7·50	3·50	3·00
19	7·50	6·00	3·25	3·00
20	5·50	5·50	3·00	3·00
21	7·50	7·00	4·25	4·00
22	7·50	7·00	4·25	4·00
23	5·50	7·00	4·00	3·00
24	7·00	6·50	3·50	4·00
25	6·00	7·50	4·25	4·00
26	5·25	5·00	4·25	4·00
27	5·00	5·50	3·75	4·25
28	3·50	5·50	4·25	4·00
29	3·50	5·50	4·50	4·25
30	3·00	2·50	3·75	3·75
31	2·00	2·00	4·00	4·00
TOTAL	149·75-inches.	159·25-inches.	73·25-inches.	71·25-inches.

This gives for *B. gigantea* a total increase in height of 25 feet 9 inches in 31 days, and shews a difference of 9½ inches in favor of the growth during day. Bamb. balcooa grew during the 23 days 12 ft. ½ inch with 2 inches in favor of growth during night time.

Increase in length in inches of Bambusa "Tulda," Roxb., Basni bans.

DATE.	SHOOT. A.		SHOOT B.		SHOOT C.	
1833. June.	6 a.m	6 p.m.	6 a.m	6 p.m	?	?
25	2·75	.....	3·00	.....	3·25	.....
26	.....	8·00	.....	6·50	8·00	.....
27	3·00	4·00	3·50	3·00	2·75	.....
28	3·50	3·00	3·75	3·75	4·00	.....
29	3·00	4·50	2·75	4·50	3·50	.....
30	3·75	.....	4·00	.....	.....	.....
1st July	3·00	.....	2·25	.....	.....	.....
	Total in 7 days, 38½ inches.		Total in 7 days, 37 inches		Total in 5 days, 21½ inches.	

The above bamboo is called by Wallich *Bambusa Tulda*, Roxb., and the native name given for it is bansni bans. There must be some mistake, for basini bans of the Bengalees is *B. vulgaris* according to my own researches, while tulda bans of Bengal is *Gigantochloa auriculata*. The shoots A. B. C. are described as follows: shoot A., a slender one, measuring on the 1st of July 1833, thus at the close of the observations, 4 feet 8 inches in length and 4¾ inches in circumference, with 20 joints, each with its leaf-sheath; shoot B., which had on the 24th June 1833 a circumference of 4¾ inches with about 20 joints and sheaths; and shoot C., of which no particulars are given.

Other measurements are given of two shoots of *Melocanna baccifera*. They shewed the following increase in growth:—

	First Shoot.	Second Shoot.
1st to 7th August 1873 ...	1 ft. 8 in.	1 ft. 6 in.
8th to 14th " " ...	2 " 2 "	1 " 8 "
15th to 21st " " ...	2 " 11 "	2 "
21st Aug. to 28th Aug " ...	3 "	2 " 6 "
Total in 28 days ...	9 feet 9 inches	7 feet 8 inches.

Dr. Roxburgh observes, that the shoots of his *Bambusa Tulda* rise to their full size, from 20 to 70 feet in height and from 6 to 12 inches in circumference, in the course of about 30 days. Dr. John Davy measured a bamboo-shoot6 days successively, one that was about 4 feet from the shoal from which it sprung. During the first 24 hours it increased in height 6·75 inches; during the second, 5·25; during the third, 4·5; during the fifth, the same; during the sixth, 4·5 inches. These observations were made between the 22nd and 29th September, and on a plant in a comparatively poor and dry soil. Mr. Fortune, who has made numerous measurements in the Chinese bamboo jungles, found the growth from 2 to 2½ ft. in 24 hours, and he found also (like myself) that the growth is greatest during the night.

I will now give the tabular results of measurements of 2 gigantic species of bamboo, *viz.*, *Gigantochloa robusta* (bamboo wooloong) and *Gigant. atter* (bamboo atter) which I obtained in 1862 in the Botanical Gardens at Buitenzorg, Java. The garden is situated at an elevation of between 940 to 960 ft. english. The measurements could for several reasons be commenced only after the shoots were much developed. As they represent only single observations they can have only relative value and thus represent only approximately the real nature of growth. However the measurements themselves were executed with all care, but the correct readings became more difficult with increasing height of the shoots, and therefore the measurements were carried on only during the first month. As the tips of the imperfect blade were taken as the extremity, it necessarily happened that periodical retrogrades in length appear in the table. They are caused by the spreading of the blade at a certain stage of development. Such retrogrades are marked in italics. Measurement of the increasing length of the internodes themselves, comparisons of such measurements, and the anatomical changes in the inner structure of the halms I reserve for a future revision of Indian bamboos.

The measurements are in French mètres, and I have not thought it necessary to reduce these to English equivalents.

The temperatures were taken by Dr. Schwarz, at the time Civil Surgeon of Buitenzorg, according to the medical usage, *viz.*, at 9 a.m., 1 p.m., and 10 p.m., and thus are barely of value for agricultural and physiological purposes, for reasons which I have given already in my report on the Pegu Forests (page 87.)

The height of the shoots of the 2 bamboos measured on the evening of the 16th December 1862 was the following: that of *Gigantochloa robusta* was 0·64 mètres; that of *Gig. atter* only 0·11 mètres.

The plantain gives much smaller values of growth in length as compared with bamboo, but in reality grows quicker than the latter, for here the lengthening takes place throughout the whole of the axis, while in bamboo it is of a double nature, lengthening of the joints themselves and production of new joints. In the plantain, moreover, the growth is very unequal and increases from

outwards to the centre. This can be very plainly seen in cutting through a plaintain stem, when we see the next day the central part, (the young leaf) protruding far above the outer concentric layers (leaf sheaths) the latter shewing gradually less vigorous growth according to the age of the leaves.

Table shewing the growth of a shoot of bamboo wooloong and bamboo atter in the Botanical Garden, Buitenzorg (Java) in 1862-63.

DATE	GIGANTOCHLOA ROBUSTA.		GIGANTOCHLOA ATTER.		Mean Temperature Celsius.	WEATHER.
Dec. 1862.	6 a.m.	6 p.m.	6 a.m.	6 p.m.		
17	0·0255	0·0101	0·0070	0·0150	24·5	Oppressive, somewhat rain towards eve.
18	0·0410	0·0175	0·0115	0·0120	24·8	Changeable, no rain.
19	0·0190	0·0190	0·0040	0·0150	25·1	Rainy, somewhat rain at eve.
20	0·0110	0·0290	0·0075	0·0105	24·9	Changeable, with rain.
21	0·0310	0·0171	0·0090	0·0065	24·8	Rain with interruptions.
22	0·0245	0·0150	0·0040	0·0080	24·4	Cloudy, but no rain.
23	0·0247	0·0132	0·0095	0·0120	24·1	Cloudy, but no rain.
24	0·0251	0·0140	0·0145	0·0125	25·4	Cloudy, with rain.
25	0·0171	0·0145	0·0280	0·0092	25·0	Cloudy, soon plenty rain.
26	0·0315	0·0173	0·0150	0·0097	24·0	Rain all day.
27	0·0345	0·0190	0·0181	0·0103	24·7	Rain all day.
28	0·0400	0·0165	0·0215	0·0125	24·0	Changeable, with rain.
29	0·0390	0·0185	0·0225	0·0115	24·1	Changeable, without rain.
30	0·0410	0·0240	0·0270	0·0150	24·7	Cloudy, clearing up; rain during night.
31	0·0645	0·0381	0·0321	0·0225	24·3	Rain all day.
Jan. 1	0·0735	0·0301	0·0360	0·0221	23·7	Rain all day.
2	0·0736	0·0363	0·0525	0·0215	23·3	Rain all day.
3	0·0715	0·0465	0·0515	0·0375	23·8	Rainy.
4	0·0742	0·0291	0·0588	0·0350	24·5	Fine and clear.
5	0·0820	0·0323	0·0690	0·0430	24·5	Fine and clear.
6	0·0937	0·0585	0·0835	0·0645	24·5	Fine and clear.
7	0·0841	0·0852	0·0901	0·0700	25·0	Fine and clear.
8	00·481	0·1350	0·0881	0·0675	25·0	Fine; rain towards eve.
9	0·0847	0·0591	0·0355	0·0461	25·3	Fine; rain at midday.
10	0·1325	0·0710	0·0570	0·0501	24·7	Rainy.
11	0·1025	0·0520	0·0660	0·0411	24·7	Changeable, with little rain.
12	0·1231	0·0701	0·0810	0·0510	25·1	Changeable, somewhat rain.
13	0·1875	0·0700	0·0775	0·0491	25·0	Rainy.
14	0·1335	0·0747	0·0630	0·0453	24·9	Cloudy, without rain.
15	0·1265	0·0770	0·1252	0·0510	24·5	Rain all day.
Total of growth	1·9554 Nocturnal	1·2097 Diurnal	1·2659 Nocturnal	0·8770 Diurnal		
Total of growth in 30 days	3·1651		2·1429			
Total height of shoots on the 15 Jan.	3·8051		2·2529			

From the above table we may be allowed to deduct a few general facts. The growth of a bamboo-shoot is increasing in the proportion as more joints are developed. The greatest activity of growth takes place during night and during fine clear days. Both these latter conclusions are not settled as yet, for serious aberrations from this rule take place which can be explained only by longer and repeated measurements, and such, no doubt, will cause considerable modifications of the above deductions.

On the 15th February, thus a month later, the total height of the same shoot of *Gigantochloa robusta* amounted to 9·75 mètres, and that of *G. atter* to 6·24 mètres, so that the former's growth during this period was 5·9449; that of the latter 3·9871 mètres. Only on the 2nd March, *G. robusta* began (then 24 mètres high) to form lateral branches; while *G. atter* did so by a height of 7 mètres on the 30th March. I must mention here that the development of lateral branches regularly takes place from below upwards, and in these two species before us the little meagre lateral branchlets that arise from above the lower nodes appear very early, while the larger ones of the last third part of the halms appear often only when the lowermost ones have already long dried up.

The rapid growth of shoots, however, continues only so long as the halms are pretty soft and porous, *viz.*, the cells very large and loose, but it is checked as soon as the lateral branches become more developed, and the consistence of the halms becomes denser on account of the rapid formation of smaller cells, woody vessels and silification. Arrived at this stage no important change takes place either in the height or thickness of the halms. I must also remark here, that these shoots often, and in certain species regularly, overtop the fullgrown halms of the preceding years and give thus a peculiar but elegant aspect to the stock. This elongation is due to two causes: first, the halms of some of the species become with maturity more spreading and overhanging, and thus appear shorter than they are; and, secondly, the height and strength of the halms increases with the age of the stock, and hence the young but fully developed shoots naturally will be the longer and stronger ones.

The number of shoots that every bamboo-stock annually pro-

duces varies greatly according to the species, and even according to the strength and vigour of each individual bamboo. The larger kinds, however, produce yearly between 12 to 20 and sometimes more shoots; some of the smaller bushy kinds as much as 20 to 50. But some of the shoots lose, for some reason as yet unknown to me, all their vitality at a very early stage, when they just have burst from the ground, and quickly die off. Hence we see so often such dead shoot-cones on most of the stocks. But even the number of shoots-yearly produced, as given above, is enormous. If we assume, say only 10 per stock a year, we should get as many as 300 halms to the stock in 30 years, which is the mean age of most of the bamboo-species at which they begin to flower and die off; while 50 and fewer halms to a bamboo-stock is a very dense growth even in those primeval forests where the axe of man does never touch them. However the many dead halms that one observes in a stock fully explains the comparatively small number of halms left. Still the explanation as to the real cause of the dying off of otherwise well-developed halms, which probably do not even come in flower, is not such an easy one, unless we assume that a greater number of halms is produced than the stock can nourish, in which case the less vigorous halms would succumb more or less slowly according to circumstances.

There exists a belief amongst natives that a thunderstorm is necessary before bamboo can shoot out. This belief is less fostered in the Malay countries than in British India, probably on account of the greater frequency of thunderstorms in the former regions. Captain W. H. Sleemann writes (Trans. Agr. Hort. Soc., Ind., IV., 190) :—"In the rains of 1835, my bamboos at Jubbalpore had not thrown out their shoots at what I considered the usual time, and I asked my gardener the cause. He replied, we have had no *thunder* yet; as soon as the thunder comes, you will get shoots. I asked him what possible connection there could be between the claps of thunder and the shooting of the bamboos. God only knows, said he, but we know that till the thunder comes, the bamboos never shoot well. The thunder came, and certainly the gardener's theory seemed to me to be confirmed by a very steady and

abundant shooting of the bamboos. Here possibly the cause rests in the increased amount of nitrogenous compounds absorbed with avidity through the humus that accumulates round the bamboo-stocks. Repeated cutting of too many bamboo-shoots considerably weakens the stock, while the cutting of full-grown halms does not more injure them than the mowing does the grass. Indeed it is believed that too much cutting of shoots results in early flowering of the stock itself and such means in most cases death to the whole plant.

The halms of the same species vary very much as well in their height as also in the nature of their surfaces and color. Usually they are cylindric with or without prominent knots. Only a few of the small kinds (chiefly Japanese and Chinese *Arundinarias*) form an exception and possess alternately semi-terete or even 4 cornered halms (see v. Siebold, Verh. Genootsch Batav. XII. 6). A furrow or flattening on the inner side of the halm-joints where ramification takes place, is present in most species. As regards the height which bamboo attain, halms are known of 140 to 150 feet in length, and Zollinger measured a bitoong-halm (*Gig. aspera*) of 170 feet. The usual height of the tallest species (as bamboo Litoong, andong, wooloong, wabo, etc.) varies between 90 to 110 feet. The thickness is in proportion of about ½ feet in 50 feet and oscillates between that of a man's arm to one foot or somewhat more. According to a communication of Mr. Rigg of Jasinga Java there were, at the exhibition of 1853 at Batavia, samples of bamboo-halms from Daya Loohoor in Banyoomas which had a circumference of 25 inches at the base, and at a height of 118 feet they still measured 22 inches in girt. On the other hand, we have in Japan and the Kuriles pygmaean bamboo of only 4 to 6 inches in height, the halms of which attain hardly the thickness of a crow's quill. These are often, as in gimmeitsik, almost solid.

The durability of the bamboo-halms depends chiefly upon the thickness of the wood and upon the amount of silica it contains. The surface of the halms is either quite smooth and glossy of various colours, as green (bamboo hower gullies and booloo idyooh), or glossy yellow (bamboo hower kouneng

and booloo konneng), or beautifully striped yellow and green (bamboo hower seh-ah); or in the greater number of species more or less rough and of a greyish green, greenish yellow, blackish green and even purplish-black colour. Sometimes they are striped dull-yellowish and green, but also (as in leleba soorat) striped with whitish yellow and rose, or (leleba tootool) similarly blotched; very rarely, as in a variety of the China bamboo (*B. nana*), occasionally orange coloured. The surface of bamboo bitoong and the Burmese Kyattounwa (*B. Brandisii*) is covered all over with a roughish greyish or dirty yellowish-grey felt easily scraped off. This felt becomes sometimes rusty or even golden-coloured below the prominent nodes. The yellow halms of booloo konneng are covered with a white fugaceous meal, somewhat resembling that which covers the inner walls of the joints; other species, like *Dendrocalamus giganteus* and booloo idyooh have them white pruinous. Bamboo tamyang sonoh owes its greater roughness and grey-green of its halms chiefly to the unusual percentage of silica it contains.

The knots form transverse solid septa in the interior of the joints, but a remarkable monstrosity of a bamboo-halm (species unknown) was sent many years ago to the Museum of the Botanical Gardens, Calcutta, which virtually has all the knots united into a perfect continuous spiral. The portion of halm sent is about 7 feet long, and as thick as an arm, but not equally thick and abruptly bluntish at the end; the windings of the spiral are from the right to the left (the axis considered in the spiral.) In plate 1, fig. 2, I have given a figure of the lower portion of it, very much reduced in size. Another monstrosity of halms has been brought home by Dr. J. Anderson from the Khakyen hills east of Bhamo (so I believe for there is no label to it), which has the joints remarkably inflated, and this may possibly be rather the result of artificial training. Also of this will be found a piece (natural size) figured on the same plate fig. 3. The original halm is 2½ feet long, the joints at the narrower part 6 lines in diameter and at the most inflated parts they measure 7½ lines.

Bamboo bitoong, the Burmese Kyattounwa, and several

other tall species emit short (up to ½ inch long) densely packed aëral roots round the knots up to ⅓ of the height of the halms; similar garlands of roots, but less developed, occur also on the basal jointings of other species (bamboo andong, atter, ietam, wooloong, etc), especially when they attain a certain age, and these rootlets usually penetrate into the soil and derive from it additional nourishment for the halms. The aëral rootlets dry up soon and encircle the nodes with a garland of somewhat spiny coarse fibres, and hence the halms of several species of bamboo are described by some authors as being "spiny." Strictly spoken there is no such thing as true spines in bamboo, for such spines are either the dried-up aëral rootlets just spoken of, or (as bamboo dooroe and the Bengalee behoor bans and a few other sorts) the recurved spinescent buds which either become arrested in their growth or more usually develope themselves into branchlets during the subsequent year.

The branches and branchlets arise always close to the jointings in half-whorls or clusters, rarely by 3 or 5, and still more unfrequently singly, as for example in leleba. The centre-branch is usually longer and stronger than the lateral ones. In Wapyoo geley (*Gigantochloa albo-ciliata*) it becomes as thick as, and occasionally even thicker than, the halm itself, while the lateral branchings use to be shorter and less ramified, or sometimes become altogether arrested in their growth. These branch-whorls arise invariably alternately from the nodes and thus appear distichous, very rarely and usually only abnormally, they are arranged in an ¼ position. The halms would therefore have a very simple plume-like appearance, as is really the case with some sorts of bamboo, but the repeatedly alternating lateral branchlets now placed in half-whorls, now singly or only few together, spread in all directions and thus give a more massive aspect to the whole. Their length is various and partially conditions the general habit of a bamboo accordingly that the branchings arise from the upper or lower portions of the halms. In bud they appear either as soft, subulate, long-tapering cones (in fact these are shoots in miniature of a secondary, tertiary, &c., order), of a more or less

spine-like aspect, or, as already mentioned above, as curved spines placed by 3 to 5. They are similarly like the radical shoots protected by many scale-like sheaths, which in a certain degree resemble the shoot-sheaths and which enlarge with the development of the branches. They usually fall off very late and are still seen at the flowering period.

The leaves of bamboo are all distichously placed just as is the case with all true grasses. They are more or less narrowed or constricted at the base into a short stalk (nearly in all species), or very rarely almost sessile and nearly half stem clasping as in a few varieties of leleba. The petiole is jointed to the sheath, a characteristic peculiarity of bamboo generally, and foresters may take this point as a distinction between bamboo and other grasses; for only very few other grasses shew this same peculiarity. The leaf-stalks of *Phyllostachys kumasasa* from Japan have been described as jointed, but more close examination has shown that this is not the case, and that those parts which were mistaken for the petiole are in reality shortened joints of the lateral branchlets, from which the lower leaves have fallen or were never developed. The leaves are usually very variable in shape and more particularly in the nature of their base. Often enough occur two and even three differently shaped leaves on the same halm, the lowermost ones arising from the meagre reduced branchlets, and the uppermost ones which are usually very much larger than all the rest. So for example are the leaves of the basal branchlets on the halms of bamboo hower and more especially of its variety bamboo hower tootool, small linear, smooth and yellowish green, while those of the branchlets higher up the halm become nearly 1½ feet long dark-green and almost roughish on the upper surface. The number of the primary and secondary nerves must needs vary in proportion to the size of the leaves. I could bring forward numerous examples that would demonstrate how little value can be attached to the size, shape and nervature of bamboo leaves. Also their consistence, hairiness and roughness depends more or less upon the age of the leaves or of the bamboo-stock. Densely crowded bunches of sickly looking yellowish green leaves sometimes depend from the ultimate branchings which remain almost

herbaceous; but more frequently still the leaves do not come at all to perfection, and the branchlets in this case are multifariously curved and simply sheathed. Both these two sickly and abnormal states are not rarely accompanied by subulate fleshy black excrescences of the end-buds caused by a fungus, and such monstrosities are often mistaken for bamboo fruits, not only by Europeans but also by natives.

The colour of the leaves is usually a dark green on the upper-side and beneath a somewhat paler green verging into grey, turning really greyish green in drying. Some species, like *Bamb. nana*, *Teinostachyum Griffithii*, *Gigantochloa macrostachya*, etc., have the leaves quite white beneath, others greyish green on both sides, but only very few enjoy a yellowish green colour. Striped (white) leaves occur in some cultivated Japanese and Chinese bamboos.

Bamboos are of two sorts, *viz.*, the leaf shedding or deciduous, and the evergreen ones, the latter class being chiefly represented in damp climates, along river sides, or in the shade of tropical forests. Deciduous bamboos, however, like yakatwa, jungli bans or male bamboo (*Dendrocalamus strictus*) etc., become often evergreen in damper climates, or when they grow in moister localities. On the other hand, bamboo normally evergreen, (such as kyattounwa, wapyoo gelev, etc.. etc.) become regularly leafshedding in drier climates or in arid localities, or become so temporarily in unusually dry seasons.

The sheaths of the leaves would offer good characters in the discrimination of the species of bamboo, if they would not loose so very readily their auricles and clothing when full grown, and some practice is therefore necessary before one can employ them as distinctive characters. Still in the hands of an expert, whose experience has taught him the necessary precautions in this regard, they yield valuable hints in the absence of shoot-sheaths. The parts that can be distinguished on a leaf-sheath are the same as those of a shoot-sheath, *viz.*, the sheath itself, its mouth with its auricles or fringes, and the ligule; the imperfect blade is here developed into a perfect stalked leaf-blade.

The inflorescence of bamboo exhibits great variations. All species of bamboo remain leafed at the beginning of flowering,

and lose their leaves only gradually as the flowering progresses. Hence we can find all stages from simple cluster-spikes to compound immense radical panicles, according to the advance towards defloration. Sometimes defoliation takes place very late; in other cases only partially or not at all, as for example in the varieties of leleba and most of the species of *Schizostachyum*. In other cases certain halms of a bamboo-stock burst into flower, lose their leaves, and die off, while the rest of the halms continues flowerless. The male bamboo normally does so regularly in India, but in Burma, especially in the dry stony laterite tracts of Prome and the Irrawaddi valley, the whole stock takes to flowering and dies off. This is the more remarkable as the same species follows the normal rule of flowering on the dry sandstone hills of the Pegu Yomah. The *Arundinarias* for the greater part use to flower freely without dying off, but a few small species growing at high elevations die off to the ground and throw up new shoots the following spring. However, the general, if not universal, rule of flowering is that the whole stock becomes affected and all the halms simultaneously burst into flower, lose their leaves, and the stock dies off, sometimes already the first year (very rarely), but more usually gradually during 2 or 3 years. The flowering is during this period so profuss that spikelet after spikelet is produced, and a flower-cluster that at the beginning had only half an inch in diameter may measure as much as two inches at the fruiting time. Indeed the bamboo stock becomes exhausted through flowering, hence Malays, as other Indians, do not like the flowering of bamboo, and cut down the halms as soon as the first sign of flowering shews itself. The Bengalees and other Indians even believe that flowering of bamboo brings misfortune.

The age at which bamboo begins to set flowers is variously put down, and nothing quite conclusive is yet known about this point. But so much we can take for certain that flowering takes place at various ages according to the species itself, and also that the flowering period is not fixed within a couple of years only. Thus the age at which the more common kinds of Malaya and India flower (chiefly belonging to the section of *Ischurochloa* of *Bambusa* and *Dendrocalamus*) ranges between

25 to 35 years, and is almost regularly followed by the death of the whole stock, although a very few exceptional cases are known to me where a shoot was thrown up and grew and formed a new stock. In India, a man who has seen two kutungs (seedings of bamboo) is considered an old man, perhaps 60 years of age. Col. Beddome is of opinion that *Bambusa arundinacea* generally flowers at an age of about 32 years, he having ascertained the flowering of the same tracts in Western India in 1804, 1836, and 1868. However, the tall bamboos of the Indian Archipelago reach an age of nearly 100 years, *i. e.*, the whole stock, not the halms, which die off at a certain age. Remarkable is bamboo ul-ul of Bandong (*Schizostachyum elegantissimum*) which flowers and dies off every third year. This sort has also comparatively the thinnest wood of all bamboos known to me, although growing up to a height of 20 to 25 feet with the halms as thick as an arm.

In the plains, and generally in the drier tracts of continental India, where only few species of bamboo grow, and these in large quantities over whole tracts of land, the simultaneous flowering of bamboo is a conspicuous phenomenon to all, and hence such occurrences are numerously recorded in agricultural journals and even in the newspapers. Thus flowering of bamboo is recorded by Capt. Sleemann in Dehra Dhoon in 1836, when all bamboos died. Lieutenant J. F. Pogson reports that all the three sorts of bamboos flowered at Simla in 1858. These three kinds were a large hollow bamboo; the female bamboo, which is rarely more than 1½ inch in diameter; and the solid or "male" bamboo, perhaps a trifle thicker than the preceding. Mr. J. D. Gash of Pertabgurh reports in 1869 the flowering of the kutwasee, one of the four sorts grown in Oude, *viz.*, kutwasee, chah, lore and phool-bassa, adding that bamboo also flowered at that locality some 25 years ago. Mr. Macalpine records flowering of a bamboo, called kulgai, in Chittagong in 1867. He mentions also the flowering there of tulla bansh (probably talda?) in 1865. Col. C. S. Ryder similarly reports simultaneous flowering of the bamboo around Jubbulpore in 1873. The berry-bearing bamboo in Arracan fruits every 30 to 35 years, and the process appears to occupy a couple of years. It flowered last

in 1864-65 over the whole of the Arracan Yomah. Numerous other, more or less reliable datas, are at my disposal of similar occurrences, but they do not tend to promote the solution of the question at issue, *viz.*, the settlement of the age at which a species of bamboo flowers, as they only state that some sort of bamboo has flowered.

On the other hand, the flowering of bamboo in more damp countries, as in Burmah, etc., is such a common-sort occurrence that it never attracts the curiosity of the inhabitants; but the Karens bring this flower-period into calculation in their toungya cultivation, for experience has taught them that the rats are attracted and multiplied in such quantities when bamboo sets fruit, that they had really at occasions to abandon their fields and to leave the produce to these voracious creatures.

But there are apparent exceptions even to those cases where simultaneous flowering is characteristic to a species, and thus bamboo hower, which after flowering dies off even in the damp Malayan countries, may be seen in Bengal flowering only on a few halms, while the stock and the remainder of the halms remain alive and vegetate vigorously. A few other such occurrences have come under my observation, and I think that these anomalies may be explained by knowing that weakening the growth by whatever means induces premature flowering. Thus we may also partially account for the dead halms that we meet in bamboo-forest, and to which I already alluded to above. Indeed it happens sometimes that we meet one or a few flowering halms even in the primeval forests under the very circumstances just described.

From my own observations, and they extend now over 20 years, I must concur with the general notion of natives that drought greatly encourages flowering, although a certain age, or say rather state of debility, seems requisite before this favourable influence can fully come into play. So for example I have observed in Burma pygmaean plants of tinwa (*Cephalostachyum pergracile*) of only about ½ to 1 foot height, which had been continuously burnt down by junglefires, and which flowered together with their unhurt companions of 30 to 40 feet height. But strugglers from seeds that germinated at a latter date (say

the subsequent year may also be seen occasionally amongst the patches of flowering bamboos without producing a single flower. In such cases we have to generalize upon the broad facts before us, and leave stray exceptions as interesting hints for the consideration of casual phenomena. Both dry seasons that I spent in Burma were described to me as extraordinary hot ones, such as the oldest people could not remember, and my harvest of flowering species of bamboo was remarkably large, so much so that I missed the flowers of few species only, and these were such kinds as grew in tropical forests or near water, and hence were not likely to be affected by drought. Never were so many species of bamboo in flower in the Calcutta Botanical Gardens as in 1874—a year of drought and famine. Flowering of bamboo during times of famine is very usual, and there is a saying with the Indian that "when bamboos produce sustenance, we must look to heaven for food." The correctness of this proverb has been challenged, but I believe upon very insufficient grounds, for although bamboo may, and does, flower and fruit in years where the most beautiful crops are harvested, it does not follow that there was no drought in that season. How important an event the general flowering is in time of famine may easily be gathered from a few facts. In 1812, in Orissa a general flowering of bamboo took place, and prevented a famine. Hundreds of people were on the watch day and night in order to collect the seeds as they fell from the branches. Mr. Shaw Stewart, the Collecter of Canara (Western coast of India) states, that in 1864 a similar event took place in the Soopa jungles, and that a very large number of persons, estimated at 50,000, came from the Dharwar and Belgaum districts to collect the seeds. Each party remained about 10 to 14 days, taking away enough for their own consumption during the monsoon months, as well as some for sale; and he adds that the flowering was a most providential benefit during the prevailing scarcity. Mr. Gray, writing from Maldah in 1866, says: "In the South District, throughout the whole tract of country, the bamboo (probably *bamboo tulda?*) has flowered, and the seed has been sold in the bazaar at 13 seers for the rupee, rice being 10 seers, the ryots having stored enough for their own

wants in addition. Hundreds of maunds have been sold in the English Bazaar at Maldah; and large quantities have been sent to Sultangunge and other places 25 to 30 miles distant, shewing how enormous the supply must have been. The bamboo flowering has been quite providential, as the ryots were on the point of starving."

Here we have at once a key in dealing with the mitigation of famines in India, and bamboo-reserves for famine years would no doubt be preferable to mahogany and other timber plantations under the shade (?) of which the Bengalee ryot could only study the effects of hunger. Such reserves are the more recommendable, as there are many wastes now uncultivated which might be used as such, and along the Ganges endless savannahs expand which might profitably give way to reserves of bamboo. But only few bamboos would be eligible for this purpose, and of these behoor bans (*Bamb. arundinacea*), dyowa bans (*Bamb. tulda*) and basini bans (*Bamb. vulgaris*) would be the preferable ones, the first one being adapted also for drier climates, like the Upper Provinces; the two latter ones are preferable for damper climates, as Lower Bengal, etc. There are other freely flowering bamboos, especially the so-called male bamboo, a kind which grows, unlike the above noted, also on sterile rocky hills, but the seeds of this kind, although larger, has a pretty large pericarp, and is by no means so productive as those kinds named above. Indeed, while here only 1 to 3 seeds to the spikelet are found, there are as many as 4 to 8, which latter do not require to have the pericarp first removed, as is the case in the male bamboo. Unfortunately we know nothing about the exact quantity of seeds which every stock yields, but we may presume that it must be enormous. We have, however, much to learn yet of the life-history of these bamboos before we can advantageously employ them for famine-purposes, and first of all we require to know the exact age at which flowering can take place. Besides, yearly after sowings are necessary so as to ensure regularity of crops, etc.* Such bamboo-reserves would at the same time

* Thus in order to obtain a single acre's yield after a lapse of 30 years, it requires 30 acres to be planted successively at the rate of one acre per year. Under such circumstances it is most important to know, whether the yield of one acre of bamboo-rice

contain also other food-plants, as for example aloo, diverse kinds (*Dioscorea sp.*) say about 3-4 plants to each stock; *Tacca pinnatifida*, ol (*Amorphophallus campanulatus*); varieties of kuchoo (*Colocasia antiquorum* and *C. Indica*); tapioca and cassava (*Janipha manihot*), and such like tuberous plants as do not interfere with the plantation, while their value would be enhanced, provided that the people would be prevented from using these products without a regulated control. Trees, like mango and jack, and in drier districts the muhooa (*Bassia latifolia*) and the carob-tree (*Ceratonia siliqua*), the latter on calcareous sub-soils, might be added or interspersed in the bamboo-grooves. Add to the above bamboo-reserves revised and strict rules regarding fisheries (for fish is an important article of food to a great class of natives); an attempt on the part of the forester to redeem the numerous courses of rivulets that are now dried up in the arid hills of the Peninsula, Behar, etc., by replanting their sources with trees and thus recreate their flow, and have these sources combined with a judicious extension of irrigation works, and I see not why famine could not be banished or at least so greatly diminished as to dwindle down to mere temporary scarcity.

Noteworthy is also the innate individuality of bamboo as shewn in its flowering. Cuttings or root-layers taken from the flowering stock (and even if taken before flowering) will burst into flower just as their parent-stock. Hence, natives use to cut down all the halms a year before flowering if possible, and thus prevent that the stock flowers itself to death. How they should, however, know, when their bamboo-stock goes to flower, can only be explained by assuming that some

(which sells lower than common rice) is equal or inferior to the yield of any crop that could be raised on the same land (which of course must be such as would be declared *a priori* unfit for rice cultivation) during the same period of time.

The densest bamboo-growth to an acre is 440 clumps, or say 400 at an average. The yield of each clump may be set down as two maunds at a minimum. Thus an acre would give 800* maunds of bamboo-rice every thirtieth year from the sowing. This, however, makes only about 26½ maund per year calculated in the proportion to the whole area occupied (30 acres). To this must be added the entire loss of products (except minor ones derived from root-crops etc.) for the period of 30, and eventually upwards to 34 years! If planted on recognised ricelands, the loss (circ. 27,000 maunds of paddy) would be enormous under these circumstances, if we take an average fair crop of paddy at 30 maunds of paddy per acre annually.

* I fear this estimate is far beyond the quantity which would actually be obtained.—*The Editor.*

premature partial flowering takes place as an indication of the subsequent total floration. When a bamboo-stock is once in flower, cutting of the halms does not check the flowering.

The inflorescence of a bamboo is virtually always a contracted panicle terminating the branchlets. Through gradual defoliation, however, originate the terminal or even the radical imposing panicles formed by the thorough flowering of the whole halm, which bears only more here and there a small bunch of leaves, the remnants of a past state. The spikelets formed of a distichous accumulation of florets, are sometimes crowded at the end of the branchlets, and separated by them by a few sheathed joints, in which case they form heads (as for example in *Schizostachyum chilianthum*,) very rarely do they singly spring from above the jointings, or casually in great irregularity between the flowering branchlets (as in *Schizo. Blumei*). In some *Arundinariæ*, however, they often appear singly and long stalked.

A spikelet (see plate I., figs. 4-6) consists in a perfect state of two basal glumes, of which one or both may be reduced or abort altogether; then follow a number of distichously placed valves, or paleas, outer and inner, in which rest the true floret consisting of tender scales, stamens or ovary or both. A bamboo-spikelet can very well be looked upon as being a reduced inflorescence, for most species (except *Arundinariæ*) have buds in the lower paleas, which develope under certain circumstances into independent spikelets. So for example, I have figured on plate I., figs. 9 and 10, whorls of spikelets of bamboo andong and b. atter, some of the spikelets of which have assumed almost the aspect of new flowering branchlets through the elongation of the primary rachis, while the buds of the lower paleas are developed into independent spikelets, which, however, have themselves become gemmiparous in their lower paleas; but the true nature of the spikelets remains still demonstrable on account of the uppermost perfect florets of the spikelet which remain in their normal state, for they are not susceptible to further development, and therefore have undergone no other change except a slight enlargement likely due to the vigour of the would-be spikelet. This phenomenon is a very frequent one with

the above two species, while in *Schizostachyum* and a few other bamboos this wonderful successive and repeated development of buds into perfect spikelets has become normal in a slightly modified way. Here we never see the sterile pedicelli (stalks) between the spikelets at the beginning of the flowering, (see plate I., fig. 7) but they appear at a latter period (l. c. fig. 8), after the buds of the lower paleas become developed and by their pressure have dislodged the upper deflorate mother-spikelets, thus leaving behind only their pedicelli. This process of development of buds continues for a long time, for also the new developed spikelets form buds in their lower paleas, while the numerous undeveloped spikelets, of which such a fascicle of spikelet is composed, become in their turn similarly and repeatedly developed.

Such whorls or clusters of spikelets are always enveloped in a sheath, which often becomes quite reduced and scale-like, while in other species it becomes much developed and remains until the destruction of the whorl itself. It is similarly shaped to those of the branch-buds, but smaller and more tender, and similarly furnished with an imperfect blade, which however is only in *Phyllostachys* well developed and persistent, while in all other species it regularly falls off or is often entirely arrested in its development. The single spikelets, too, are furnished at the base with similar smaller sheathlets which now partake more the shape and consistence of bracts, now that of glumes; in *Phyllostachys* they are also often furnished with an imperfect blade. Most distinctly developed appear the glumes in the pedicelled spikelets of *Arundinariæ*, and in those bamboos where they become casually pedicelled, while in sessile spikelets (thus in most true bamboos) they are totally arrested in growth or only rudimentary.

The outer paleas are variously shaped according to whether they are taken from the lower empty or the upper perfect flowers, but they are very constant in their characters *inter se*, and only casually excurrent into an imperfect blade (*Phyllostachys*). They are concave or involute, of a coriaceous or papery consistence, keeled or not, slightly striated, nerved, or in a dried state, often channelled, fringed or nude on their margin, bluntish to long-subulate-pointed. The inner paleas are usually of a more tender

consistence, shorter or longer than the outer ones, depressed or flat on the back and double-keeled, with the keels and inner margins fringed or nude; but in *Schizostachyum* they are also terete with their margins more or less involute. For generic distinction, the inner palea of the hermaphrodite florets furnishes reliable characters.

The flowers of a bamboo-spikelet are always distichously arranged and usually manifestly so, rarely so to a less degree (caused by the overlapping of the outer paleas) in *Schizostachyum* and some other genera. The development of the flowers in a spikelet takes place successively from below upwards, so that the lowermost ones are long deflorate before the upper ones begin to develop themselves. This circumstance must partially also explain why it takes such a long period, before a bamboo-inflorescence becomes wholly deflorate. The uppermost floret is usually rudimentary and small, often pedicelled and somewhat exserted, but also as often reduced to an outer palea or to only a sterile pedicel. In some species of *Schizostachyum*, the uppermost floret not unfrequently becomes developed and perfect. In *Dinochloa*, *Beesha*, etc, is the uppermost floret always perfect and hermaphrodite, but in many other genera there is no definite rule, and the spikelets become now all unisexual, or only one or the other of the florets becomes hermaphrodite, or under certain favourable circumstances all florets become hermaphrodite, except the lowermost bud-bearing paleas. The development of hermaphrodite florets seems to stand in some connection with climatic influences or more probably with the exhaustion caused by wholesale flowering. Thus I found in the Botanic Gardens at Buitenzorg in 1862 only hermaphrodite florets on the stocks of bamboo andong (*Gigantomaxima*) then abundantly flowering, while in 1863, thus the following year, the unisexual florets appeared in the usual preponderance in all the spikelets of the same stocks I had examined the preceding year.

Until now we have observed in the arrangement of the vegetative parts an almost immutable distichismus: indeed from the very halm-shoot to the branch-shoot, the leaves, the glumes and paleas, we can perceive a regularity of repetition of the same

parts which at once point to their analogy in spite of their unequal development and modification. But in the true floret the arrangement of the parts becomes ternary or a multiple of three.

The lodicules, small scales surrounding the ovary outside the stamens, take the place of petals, and their normal number is 3, rarely fewer by abortion, or they are regularly absent. In *Beesha*, a very anomalous genus, their number is increased to 6-8. Their presence or absence is in most species constant, but in a few species of *Schizostachyum* they are present or absent in spikelets of the same inflorescence. If present, they are fringed or naked on their edges, entire or lobed, of a hyaline texture, but in the *Bamb. nana* they become sometimes quite fleshy and rounded at the base.

The number of stamens is mostly 6, usually placed in 2 whorls of 3 each, occasionally and abnormally it is increased to 7-8, or in a similar manner reduced to 5 or 3-4. In *Arundinariæ* they are normally 3 in number, but the late Mr. Wichura has found a Japanese species, of which the stamens regularly number 4, 2 of the inner series being suppressed. *Beesha* has as many as from 7 to 30 stamens! The filaments are either short and just peeping from the paleas, or very elongate and pendulous, free or in a few genera united into a tube. The anthers are 2-celled, but the cells are often longitudinally incurved, and for this reason appear spuriously 4-celled; the connective is subulate produced or blunt. I find their colour tolerably constant in the various species I have been able to examine in a living state, and this varies from purple to sulphur and green, but sometimes also two-coloured. As is well known, the stamens of bamboos are protandrous, that means, the anthers are developed and shed their pollen before the stigma of the same floret is fit for receiving the pollen: hence fecundation of the ovules can take place only by the pollen from other florets and this is effected by winds.

The ovary, which occupies the centre of the floret, is linear-flask-shaped, oval to nearly pear-shaped and oboval, sessile or (*in Phyllostachys*) spuriously stalked. The style is nearly wanting, very short or very long and filiform, tender and caducous, or in the so-called berry-bearing bamboos stiff and

straight or fleshy, undivided or terminating into 2 or 3 plumose stigmas. These stigmas are remarkably constant in colour, either white or purple, or (in leleba and the male bamboo) white with purple hairs intermixed.

The ovary engrosses in two ways, forming either the normal bamboo-fruits (see plate II., fig 14-16), which resemble those of other grasses, as oat, wheat, etc., and possess a membranous pericarp only; or they grow out into "berry-like" fruits (see plate II., figs 13 and 17 and 1-2) which were supposed by Colonel Munro to be surrounded by a perigynium like in the sedges (*Carex*). But this view, on a more careful examination, has turned out to be unfounded, for this supposed perigynium is virtually nothing else but the indurated outer wall of the ovary (pericarp), while the inner stratum of looser cells becomes detached from the outer wall and remains as a spongy mass round the true seed. The ripe fruits are very characteristic for the several genera, but unfortunately many of the species rarely fruit, and some are not yet known to have fruited at all. Their shape and structure varies greatly. Most of the species have small fruits only with a thin membranous covering, and are similarly shaped as in wheat, oat, etc. (see plate II., fig. 14, 15, 16). The largest bamboo known to me (*Giganto. aspera*) has also the smallest fruits! On the other hand, the fruits of most *Schizostachya* (see plate II., fig. 1-2) are rather large, the size of a lentil to that of a pea, and terminate in a stiff, longer or shorter beak. *Pseudostachyum compactum* (see plate II., fig. 13) has irregularly globose fruits, the size of a small wood-apple, which germinate already while still attached to the mother-plant. This has also the largest seed of all bamboos, the pericarp being thin and coriaceous. Still more interesting are the fleshy fruits of *Melocana baccifera*, which attain 4 inches by 3, and besides terminate into a fleshy beak about two inches long, so that the whole length amounts to 5 inches! Here the seed is comparatively small, while it is the fleshy pericarp which make the fruit so bulky. These also germinate while still growing on the plant, and Mr. W. L. F. Robinson of Rungpore thus describes the germination: "A good watch was kept on those fruits on the trees, and the result is this,—as they get

ripe, out of the big end, by which they hang from the tree, springs a young bamboo-leaf and also a bunch of roots; when the young shoot is some 6 inches long, the whole thing drops off the tree, and apparently plants itself in the ground by the roots. It seems a queer thing that the bamboo should reproduce itself on the tree without going to the earth first."

The bamboo-fruits, usually accompanied by the somewhat enlarged lodicules (if present), and both paleas, as well as the rudimentary florets, readily drop from the plant and germinate usually within the first week after they have fallen to the ground. They may, therefore, be reckoned amongst the quick-germinators. Nothing, however, is known as to the length of time that bamboo seed retains its vitality, although in the case of those species, which germinate already on the tree, we can safely assume that they are utterly perishable.

The vital activity of the seed commences on the fourth to the seventh day after they have been sown, and the subsequent development takes place pretty fast. On plate II. fig. 1-12, I have illustrated the germination of a seed of a so-called berry-bearing bamboo, *viz.*, that of booloo akkar (*Schizostachyum chilianthum*). Here the lower blunt end of the cotyledon (l. c. fig. 6) protrudes about the fourth day after sowing through the pericarp, and is followed the next day by its upper part (l. c. fig. 7). Already the following day the primary rootlet, which is hairy, forces its way downwards to a considerable length, while the upper part has enlarged and separated into two equally large lobes which are separated from the downwards growing part by a more or less distinct constriction. These two lobes enclose in their axil the plumule which is stiff, hairy and striped and quickly protrudes from between them, as can be seen in fig. 9 (3 days later). The subsequent stages of development of the young plants are represented in figs. 10-11, as observed on the eleventh and fifteenth day after sowing. At the latter stage the growth of the plantlet becomes considerably slower, and although still connected with the seed, the cotyledon was entirely absorbed already before the fifteenth day of sowing, and thus the young plant is left to itself for further nourishment from the soil alone. On the thirtieth day

after sowing, the halm-sheaths and a leaf are fully developed (see fig. 12), but instead of seeing the growth now accelerated, it becomes considerably slower, so much so, that after a lapse of a year the plants reached only 2-2½ feet in height. The same slow growth of the young plants prevails in behoor bans, junglee bans or male bamboo (*Dendro. strictus*), and dyowa bans (*Bamb. Tulda*), which all attain only about 1-1½ feet height in the first year, and do not exceed 4 feet in the third. Other species apparently grow quicker, and so *Melocana baccifera*, of which the fruits drop from the plant after they have made shoots some 6 inches long; these shoots attained a height of 15 to 16 inches after only 10 days that they were planted out in the ground, but had thrown out only 2 leaves. However other and more reliable observations are required, before we can come to final conclusions as to the growth of bamboo in its first years after sowing. The time required for the full development of the larger kinds of bamboo in the Malayan Archipelago oscillates between 12 to 15 years, but Captain Sleeman estimates the time required for the full-growth of bamboo in Deyrah Doon at 8 to 10 years only.

The propagation of bamboo from a practical point of view can be effected in four ways, *viz.* :—

First, by seed, the slowest mode, but the easiest, and at the end the most advantageous.

Second, by cuttings. This mode is very commonly adopted by natives, and as easy as the propagation of willows. Any joint with a node on it, even if taken from the main-halms, will strike root, provided the necessary moisture is applied.

Third, by taking only the lower part of a halm with a piece of the rhizome, and treating it in the same way as the cuttings. This method is generally in use all over India and the Archipelago, and yields vigorous clumps in the shortest time possible.

Fourth, by taking whole halms with their roots and burying them lengthwise in the ground. By this process the alternating branch clusters send forth young branch-shoots which gradually become transformed into stronger and stronger halms in the proportion as roots are formed. Thus large areas can be planted with little trouble.

It is hardly necessary here to add that all these 4 modes of propagation have to be carried out with the setting in of, or during, the rainy season. Care should also be taken that the cuttings, etc., be not taken from flowering stocks, as they may be sure to flower like their parent-stock and die off, or certainly remain weak and make little progress in growth.

(*To be continued.*)

The following 3 papers were written for the late Forest Conference at Simla, and made over for publication to the Indian Forester.—THE EDITOR.

On the formation of lac preserves in the forests of the Central Provinces.

BY J. MCKEE.

MUCH has lately been written about the Coccus Lacca and the resinous substance deposited by this insect known as Lac. Mr. O'Connor, Assistant Secretary, Department Revenue, Agriculture and Commerce, in a note published a short time since, gives a most interesting account of the important part played by this article in the commerce of the country, and the extent to which it is exported to Europe; he also appends a report by Dr. Carter, F. R. S., on the natural history of the insect, about which very incorrect ideas existed up to that time. This paper can add little new matter to the information already procurable on these points, and will rather confine itself to describing the method of propagation as practised in the Central Provinces and noting the chief points to be regarded in the formation of lac preserves.

It would appear from the table published in page 17 of Mr. O'Connor's report, that the average exports of shellac from Calcutta during the three years previous to 1874, equalled cwts. 63,381 or maunds 88,732, which, if valued at the moderate rate of Rs. 80* per maund, must have been worth Rs. 70,98,560, or nearly three-quarters of a million sterling; besides this, however,

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* Present quotations are Rs. 85, and the price has risen as high as Rs. 100 per maund.

large quantities of sticklac must also have been shipped for transport to foreign countries.

We learn from the same report that in England and on the Continent shellac is extensively used in the manufacture of sealing wax, liquid varnish and the composition of certain inks, and is now in universal demand as a substance employed in the manufacture of hats. In this country, where large quantities of the article are also consumed, it is chiefly worked up into ornaments and varnishes, the red coloring matter, which is now only exported in small quantities, being used as a dye. The natives employ raw lac in making the bangles worn by the lower classes, while the best shellac is turned into similar ornaments of greater value, as also into beads and rings. Lac is employed too as a vincer on cabinets, toys and images, and is applied as a cement in the composition of the polishing grindstones used by lapidaries. The raw material is supplied from most parts of India, *viz.*, Assam, Bengal, and Burmah, but a very large proportion of the whole appears to be collected in the Central Provinces, the trade returns of which place give the following quantities under imports and exports for the past five years:—

Imports	1870-71	...	Maunds	8,505	Rs.	1,29,882
„	1871-72	...	„	4,578	„	71,510
„	1872-73	...	„	1,217	„	14,164
„	1873-74	...	„	3,328	„	51,473
„	1874-75	...	„	10,245	„	2,67,738
Exports	1870-71	...	„	16,423	„	2,17,957
„	1871-72	...	„	36,880	„	5,17,436
„	1872-73	...	„	25,581	„	6,15,157
„	1873-74	...	„	58,069	„	12,57,000
„	1874-75	...	„	82,521	„	26,22,915

From these figures it will be gathered that the exports have increased five fold in quantity and twelve times in value during the period for which they are given, *viz.*, between 1870-71 and 1874-75, and that the gross estimated value of the lac sent out of the Provinces now amounts to over 26 lacs of rupees, or Rs. 31 per maund.

The imports are mostly from the adjoining states of Rewah and Bhopal; but as the quantity that comes into the country

is supposed to be consumed partly in the Jubbulpore factory and partly in the local trade of Boorhanpur, where it is used in glazing pottery and the manufacture of native bracelets, the quantities quoted here as exports must be nearly all collected in the Provinces.

The increase in the trade of shell and stick lac has been so remarkably rapid, and the prices obtained in Europe for the manufactured article so large, that the attention of Government has lately been attracted to a scheme for developing the production of the raw material by introducing colonies of the insects into parts of the reserves under the Forest Department, and encouraging their propagation. At present nearly all the lac is collected by private individuals from the unreserved and private forests; in the former the right being sold annually to the highest bidder, while in the latter most of the large firms interested in its manufacture have obtained leases ranging in period from 8 to 10 years, a tenure which gives them the opportunity of increasing by cultivation the ordinary natural yield. It is well known that large sums of money, amounting latterly to about 15 lacs annually, are circulated throughout the Province in the collection and manufacture of this material, much of which as before stated is obtained from the Government forests, but strange to say, in spite of its being usually classed as one of the most valuable minor forest products, the state has never up to this time reaped any considerable gain by its sale, probably not more than Rs. 15,000 per annum; the reason given for so small a revenue being realized from this source is, that up to the present the leases of Government forests have never exceeded a year's duration, in which time it would not be possible for the purchaser to do more than gather the lac which had established itself in the natural course of events, a process, compared with that of artificial propagation, causing much delay and an excessive expenditure in the collection of a necessarily uncertain yield. By a late order of the Chief Commissioner, however, the periods of these leases have been extended to 8 years, a concession no doubt calculated to increase this item of revenue in the future. The reserved tracts under the immediate superintendence of the Forest Department pre-

sent so many facilities and appliances for the production of lac, which do not exist in the less-strictly protected private and unreserved forests, that in spite of their comparatively small areas they may be looked on as the future medium for supplying the greater portion of the demand. The private individual must keep up a large establishment to search for and collect this product over an indefinite extent of country, or should he propagate it artificially, a method resorted to at present in only a few places, a still larger staff will become necessary for the formation of the plantations and their protection, while many failures and disappointments must result from the destruction of the nurseries or deterioration in the value of their produce, caused by the almost annual occurrence of forest fires. In the reserves however extensive areas have been protected successfully from fire for years past, while the establishments which will eventually be necessary for their management will be nearly adequate to superintend the additional work, and be the means of lessening the cost of producing the article; and this may be further reduced by the fact that the State could at less expense fully stock the land with trees up to the point at which it would yield a maximum out-turn of lac per acre and could better afford to spare the time necessary for this result. In short, there is every probability that owing to the advantages possessed by the reserves lac may be produced by the Forest Department far cheaper and of better quality than it could be raised by other agencies, and that, should the demand for the article continue of sufficient magnitude to induce Government to produce it on a large scale, the time must come when it will be to the advantage of the manufacturer to purchase his supplies from our depôts.

If the above reasons appear sufficiently stable to justify the State in these expectations, then the only other points which seem necessary to be determined are first, whether the State can afford to put aside areas of forest land adequate for this special work without affecting the needful timber supply; and, secondly, whether it can reasonably hope to realize from it a fair pecuniary advantage On the first point there can be no doubt as regards these Provinces, where the areas of the present

reserves could, if desirable, be extended without difficulty; and on the second, the figures at our command tend to demonstrate that the undertaking would be highly profitable. To prove this it will be essential, first, to shew the cost of preparing a given number of trees, or as I have termed them lac standards; secondly, to shew the yield that may be expected from them; and thirdly, the money value of the same.

With regard to the cost, this will necessarily vary with the description of the trees employed for the purpose, and the proportion they bear to one another in numbers on a given area. Such trees as Pallas (B. frondosa) and Ber (Z. jujuba), which are of comparatively small size, and which are found in many places in a state of almost pure forest, will necessarily cost less to bring under cultivation than larger species, such as Koosum (S. trijuga), Gooler (F. glomerata) and Peepul (F. religiosa), which are generally found either scattered about the forest or fringing the slopes of ravines and the banks of the rivers, for less brood lac will be required for their treatment and less trouble and time employed in searching for them; but on the other hand, the larger outturn obtained from the latter species will more than repay the extra money expended in preparing them. Our experiments extend at present to having operated on 7,167 trees of the Pallas and smaller species, and 1,903 trees of Koosum; these numbers represent the standards on which the insects are doing well and do not include a large percentage which turned out failures. The total cost of bringing the above under cultivation, including all charges, such as collecting brood lac, attaching it to the trees, &c., averages Rs. 3-5-11 per 100 trees of Pallas and Rs. 15 per 100 trees of Koosum. Owing to the dryness of our summer and the great damage to the lac caused by the hot winds, it does not seem probable that we can look forward to even two good crops in the year; the summer one will probably in almost all places, except those very favourably situated, be of poor quality and the quantity of lac developed not more than sufficient to leave on the trees for producing the crop which matures during the cold season. This latter will generally be good and must be the one we depend on for a return. Reckoning then on only one crop a year, and

estimating the yield per tree at the moderate quantities of 3 seers for Pallas and 15 seers for Koosum or trees of like size, we obtain a net outturn, after deducting 25 per cent. for wastage in drying and packing, from the Pallas and small trees of maunds 5·25 per 100 trees, and from the larger species of maunds 27·32, which, if valued at Rs. 15 and 20 per maund respectively will be worth Rs. 81-6 for the former, and Rs. 511 for the latter. Take from these sums the cost of producing the article, which in future will be, if any thing, less than heretofore, owing to the lac being obtained in one spot, and the net profit on 100 trees of Pallas will equal Rs. 81 and on the same number of Koosum Rs. 526. Large areas of forest are now available on which the number of Pallas and other suitable trees per acre quite equal or even excel the above unit, and the expediency of forming plantations of Koosum which area for area would yield a more valuable crop is under consideration.

Now with regard to the cultivation of the product. In forming preserves for the production of lac the first point to be considered is the species which it will be desirable to utilize as nurseries; the most favourable will be first, those which are found in largest numbers on a given area, always provided they are suitable for the purpose; secondly, that species from which the finest lac is obtained.

In the Central Provinces, lac is generally found on the following :—

Schleichera trijuga	...	...	Koosum.
Butea frondosa	...	...	Pallas.
Zizyphus jujuba	...	...	Bér.
Zizyphus xylopyrus	...	...	Ghoureo.
Ficus religiosa	...	...	Peepul.
Ficus indica	...	...	Barghat.
Ficus glomerata	...	...	Gooler
Ficus venosa	...	...	Pakhar.

But experiments have proved that it will also form on—

Tectona grandis	...	...	Sagon.
Acacia catechu	...	...	Khair.
Pterocarpus marsupium	..	...	Bija.

Terminalia tomentosa	...	...	Saj.
Dalbergia parinculata	...	...	Dhobeyne.
Lagerstroemia parviflora	...	...	Lendya.
Ougeinia dalbergioides	...	...	Tinsa.
Kydia calycina	...	...	Barranga.
Eriolæna Hookeriana	...	...	Buti.

Of the above trees the light golden resin obtained from the Koosum is the finest, as from it the most valuable orange shell lac is manufactured, and next in quality is that obtained from the Pallas, which yields the garnet lac of commerce; wherever possible therefore the Koosum tree should be chosen for standards; but as the Pallas is generally found in much greater numbers, area for area, its produce will nearly compensate in quantity for the reduction in its value. Having selected the forest for experiment, the next point to fix on is the local date on which the insects leave the parent cells, a step of great importance, and one on which the first success of the plantation will very greatly depend; as, should the work of gathering brood lac be delayed until visual proof of the exit of larvæ is obtained, a vast quantity will be killed in the operations of collection, transport, and of tying the encrusted twigs on the standards selected for nurseries. The date of evolution having been fixed on with some certainty, twigs of that season's lac should be gathered about 15 days before, wrapped up in a few straws of grass and attached to the trees selected for production, with threads of Pallas root fibre or something else as easily obtained; each twig should be from 9" to 1' in length, and be attached to the upper and middle branches of the tree. The grass tied round the twigs acts as a means of communication from the lac to the branches and leaf petioles, by which many insects are saved that would otherwise die from want of nourishment: as owing to the crookedness and irregularities of the encrustations contact between them and the branches is seldom complete. It is also of importance to tie the brood lac to the upper and middle branches, as many of the lower ones, by this arrangement, become covered with insects, which are shaken or fall from above; whereas, if the lac be attached to the lower portion of the tree, many larvæ must fall to the ground and be lost. When

attaching the twigs it appears necessary to take care that the wood of the standard is not of denser composition than the wood of the tree from which the brood lac is gathered, as it is believed that the larvæ reared on soft wooded trees are comparatively weaker than those which are found on species of harder texture. There is an idea prevalent among the Gonds that nursery standards must be prepared with brood lac taken from the same species as themselves; but this has been proved to be incorrect. The brood lac yielded by the koosum, a very hard wooded tree, appears best suited for propagating purposes, as it succeeds on trees of all other species. When several trees of the selected species grow together, it does not appear necessary at first to artificially cultivate more than three-fourths of them, as during the succeeding evolution the remaining fourth will almost certainly be brought under preparation by natural means,* but as the success of the crop depends principally on the supply of juices obtained by the female insects during the period they continue to deposit the resin, it is necessary to place the brood lac on the youngest and most sappy branches.

Lac preserves may be formed by carrying out the above simple operations; but it is not probable that success will be attained at once or until experience has drawn attention to several peculiarities in the habits of the insect and the manner in which it is influenced by situation and atmospheric conditions. Our first attempts were made in the cold weather of 1874, but owing to the want of knowledge that prevailed on several essential points, both among the superintending staff and the laborers employed on the work, the extent of these were naturally limited and of small result. It was not known with any certainty when the exit of young larvæ commenced, or what was the best method of applying them to the trees; thus a large number were lost, and this destruction of insect life was greatly increased by the rough handling they were exposed to by the workmen.

* In 1874 1,800 trees were prepared at Kosai in the Satpura Reserve, in 429 of which the lac was destroyed during the hot weather of 1875, leaving 871, from the encrustations of which a new brood of larvæ swarmed in July 1875. The lac on these trees was not touched, owing to its being a bad crop, but was left for further propagating purposes. On the 19th August however, an enumeration of the trees on this spot proved that new lac was then being formed on 1,380 trees; thus 509 trees must have been affected by their proximity to the old standards.

In one instance a plantation which had been prepared and was progressing well was nearly destroyed by mistaking an evolution of male insects for one of larvæ,—an error into which it would be impossible to fall except through want of knowledge of the insect's habits; in another, the colonies were greatly damaged by a fire which broke out and destroyed the lac—on all but the highest trees; while in a third frost and hot winds killed the females and stopped the formation of lac on nearly half the number of trees prepared. But although we had to contend with so many mishaps, partly through ignorance and partly from physical causes, each experience in its way taught valuable information which will render more certain our future undertakings.

Of the points to be noted in making these preserves the one of greatest importance perhaps is the fact that the lac encrustations may be plucked several days before the larvæ appear,—a knowledge of which will enable a larger number of trees to be prepared during one working season than if it was necessary to delay the operations until the evolution actually took place, as owing to this latter being nearly simultaneous in and about one locality, the period for forming the plantations would be necessarily limited to the number of days it took for the cells to become empty, besides which, by attaching the lac twigs before the birth of the larvæ great numbers are saved, which would otherwise perish during the process of being attached to the trees. In support of this fact it will be interesting to give the following observations: Mr. Thompson, Deputy Conservator, in order to fix on a safe date for gathering the brood lac, caused twigs, covered with the encrustations, to be brought in from the surrounding forest every two days for examination, there be labelled, dated and hung up in the verandah of his forest bungalow; the first twig was gathered on the 10th June, and the others on every succeeding alternate day until the 12th July. These twigs were the produce of several trees, and were brought from various parts of the forest within a radius of 10 miles; some were plucked from the Gooler, others from the Peepul, but the majority from the Pallas. On the morning of the 13th July, according to custom, Mr. Thompson examined

the twigs, but found no sign that the larvæ had vacated their cells, although microscopic observations had proved them to be fully developed. On the 14th however an inspection showed that, on all the twigs without exception, the young were pouring out of the cells through the anal apertures; thus the twig gathered on the 10th June hatched exactly on the same date as the one gathered on the 12th July, or more than a month later. The same fact was accidentally discovered on quite a different plantation in the following manner: A large basket of stick lac collected from the koosum tree was brought to the forest bungalow on the 7th June, being then 2 days old, and put aside in a store room as being unripe and unfit for use. On the 28th of the same month however, on being casually examined, this lac was found covered with young larvæ which must have made their appearance about 24 hours before: in this case the stick lac had been plucked from the trees and thrown aside for 23 days and turned out useful for propagation after all. These two facts prove that the encrustations may be gathered from two to three weeks before the exit of the young, by which, as before explained, much better results will be obtained than if it was necessary to delay the work until this event took place. The date of exit varies considerably in forests separated one from another by comparatively short distances. For instance, the brood hatched last season is reported to have made its first appearance at Korai on the Satpuras on the 28th June, in the forests of the Western Division situated on the same range of hills, but about 50 miles to the south of the first named place, during the first week of August, at Mohurli, in the Chanda District, about two degrees of lat. further south, on the 14th July and at Ahei still further south in the same District, a few days earlier. These dates do not point to a difference in the lat. of forests being the origin of the variation noticed, and it is more probable that in these Provinces, which are situated in the centre of the insect habitat the disagreement in the dates of birth are caused by certain local conditions. The above dates refer to the summer evolution; the winter one issues from the end of October to nearly as late as the middle of December, but the exact dates of this last in the different plantations have

not yet been definitely fixed. While on this subject it is necessary to draw attention to the reported variation in the number of evolutions and consequently in the number of crops which are obtained in different countries. In Mysore and Burmah it would appear that three evolutions of the insect take place during the year. At para. No. 21 of Mr. O Connor's report he states that in the former place "the insects are applied to the trees three times in the year, the old branches with the insects on them being lopped off, made into small bundles and tied up to fresh branches," and in an addendum to his note it is stated by a late Burmah Forest Officer that "every four months or thrice a year the lac is collected, and thrice is the lac with the ova put on." As in the Central Provinces only one good crop a year can be hoped for at present, it would be interesting if the Forest Departments in Burmah and Mysore would give some details of the method employed in cultivating the insect in those countries, as possibly by attention and careful treatment the crops might be increased in these Provinces, a matter of much importance, as thereby a larger revenue would be realized, or the same quantity of lac obtained from a smaller area.

After the larvæ appear, they crawl about the stems of the plant in search of young juicy spots, from which, when once fixed by their probosces, they cannot be removed without fatal injury. The male and female are identical in size and shape, and both commence at once the formation of their cocoons by excreting a substance resembling lac, those of the male being void or elliptic in form, while those of the females are more circular and exhibit three distinct apertures arranged in triangular fashion in their roofs, (one being the anal aperture through which impregnation is accomplished, and the larvæ eventually swarm); the other two, those by means of which the insect obtains a supply of air. About 10 weeks after birth an important change has taken place in the larvæ, the female cocoons are completed, and the insects have assumed the final or imago state; but as the female never shifts her place but remains fixed in the position she first of all took up on the twig, the male is obliged to seek her, which he does by leaving his cell in a backward manner to the ventral aperture and crawling on

to the female cells, where he fulfils his office and almost immediately after dies. This exit of male insects is a fact well to know, as owing to the smallness of the animal and to the naked-eye his similarity to the original larvæ form, it is possible for a novice to mistake such an evolution for one of young larvæ and to commence gathering the twigs under the impression that a new birth of these latter had taken place. In fact, as above mentioned, such a mistake actually happened in one of our experimental plantations, causing its almost entire destruction; for it is obvious that if the lac is plucked before or immediately after impregnation has been accomplished, the females must perish from being cut off from their sap supplies, and as a natural consequence the young brood must be destroyed with them. This mistake however may easily be avoided, for the lac at this period is so little developed compared with its after growth that no one at all acquainted with its final appearance could imagine it to be fully formed at the date when the male evolution takes place; besides which, the filamentous processes which give to the lac the downy appearance so familiar to it, only increases rapidly after this period. Impregnation having been accomplished the female busies herself in sucking up large quantities of vegetable juices, increases greatly in size and begins the excretion of the true lac.

The females must be attached to young twigs by which bountiful supplies of fluid will be supplied them, otherwise they will die or never become fully developed, the lac cells will be small in consequence, and the eggs badly effected both with regard to number and condition.

This no doubt is the reason why in districts where the seasons are dry and where showers are of unfrequent occurrence during the hot weather, the summer crop is invariably poor and scarcely worth collecting. Moisture is one of the great essentials for a fine crop of lac, and many disappointments, if not total failure, will result by fixing on dry arid spots for the formation of plantations. The females cannot obtain sufficient nourishment at this period from the sapless stems, and their death will be recognized by the pitted appearance assumed by the cells, the crowns of which fall in as the insect contracts within them,

and by the cessation of the growth or disappearance of the white filaments which obtrude from the spiracular orifices. Species, such as koosum and gooler, which most frequently are found growing along the banks of rivers, where the atmosphere is humid and moist, are, for these reasons, especially adapted for yielding good crops of lac; while the pallas offers advantages, as its sap-producing functions are actively employed during the hottest season of the year when it forms both new wood and leaves.

Besides the damage brought about by fires, drought and frost, which to some extent can be guarded against, there are other enemies to the crop which are still more difficult to contend with. Mr. Thompson writes: "The ant both large and small attends the female cells for the purpose of licking up the sweet excrement: they do not appear to hurt the insect beyond biting off the ends of the white filaments, and thus bringing many an occupant of the cells to a premature end by cutting off the supplies of breathing air which the filaments serve to convey through the holes in the lac. Where ants are seen about the lac it never appears healthy, and many cells are found with the insect dead inside them. The lac whilst on the tree is also attacked by the larva of a moth, which appears to be a species of Galleria belonging to the ninth section of the Nocturnæ named Tineites by Latreille, one of which is famous for eating into the honey comb of bees, living on their larvæ and destroying their wax. Our insect eats the juicy females of the coccus and bores through the lac cells; it is found both in the field and the store room. A second species was also detected, which appears to belong to the genus Tinea." The ravages of these insects destroy the coloring matter contained in the females, and also all hope of a brood of young from the cells visited by them. At present there seems to be no way of protecting the lac from their depredations. The ants however may be circumvented, in two ways, either by surrounding the trees with wood ashes, or something sufficiently attractive to draw their attention away from the encrustations.

It seems possible, owing to the great drain made on the sap of the young branches by the insects, that considerable damage

will be found to result to the trees on which they are propagated, and that it will be necessary at some future time to fix a limit to the continuous cultivation of lac on the same tree; at any rate it will probably be found beneficial to both lac and tree, if a regular system of pruning be carried out to encourage the new formation of young twig or branch wood, and on the best methods of doing this, and on all other points in connection with the management of lac preserves we greatly hope that officers of the Department, who may have gained experience in this work in other countries, will convey all information available through the medium of our new forest periodical.

Kath or Catechu Manufacture.

By J. Macrae,

Deputy Conservator, Guzerat.

Kath-Catechu is extracted from the heart wood of the kheir tree, *Acacia catechu*. People employed in its manufacture are called Kathodias, an aboriginal tribe much resembling Bheels, with whom they occasionally, but not often, intermarry.

The men bring in the kheir wood from the jungle and cut it into chips; the women boil the chips and extract the kath.

The tree best suited for the purpose is one of about from 25 to 30 years of age, and the more distinctly thin white lines are perceptible in the heart wood the greater the quantity of kath it contains. The Kathodia tests whether the tree will pay to cut down by cutting a small notch into the heart wood.

After the tree is cut the Kathodia removes all the sap wood and a little of the heart wood with it, from the bole, and takes it home to cut into chips, which he does with a small axe of a peculiar shape; the log is held in a slanting direction on forked stakes buried firmly in the ground.

The end of the log rests on a piece of hard wood let into the ground, and the Kathodia keeps shaving it round and round to a point.

The chips are about the thickness of wood used for match boxes and about a square inch in surface.

The chips are boiled in small earthen pots, with rather more than two quarts of water; the chips are renewed three or four times a day, three or four handsful being put in each time. The water is poured off from time to time when considered sufficiently impregnated with kath into two pots kept on purpose, and allowed to go on boiling; fresh water is put into the pots from which the liquid has been poured off.

At the end of the day the infusion in the two pots is poured into a wooden trough, about a yard long and eighteen inches broad, and goes through a peculiar process of straining. A woman takes a piece of blanket about a foot square, dips it into the infusion, stirs it about and then rings it out again into the trough, holding it as high up as she can from a sitting position. This process goes on for about two hours, after which the trough is covered up with a cover made of split bamboos, and the infusion allowed to throw down a sediment, which is kath; all the water is poured off and the kath is made into small pats and allowed to dry.

Kath, ready made, is sometimes found in the centre of some trees. This kind of kath is the most valuable, and is called khyrsal.

The Kathodias are employed in large gangs from 50 to 75 families (each family represents a kath furnace) by contractors who obtain permits from the Forest Department for the manufacture of kath, and make their encampment near a river or large nulla in the jungle so as to have a large supply of water at hand; a kath furnace has from eight to twelve pots placed in a double row. The two centre ones are used to pour the liquid into from the other pots.

The contractor buys the kath from the Kathodias at 12 or 16 pots for a double pice equal to six pies, about 4lbs for the rupee.

Kath-manufacture is very destructive, and should never be permitted in jungles where the kheir grows straight or is accessible. If allowed, only such trees should be marked as are not fit for timber, by reason of their crookedness or other defect.

In the Bombay Forests, where manufacture of kath is allowed, none but crooked trees unfitted for timber uses are felled, and every tree is previously marked for the axe by the Forest Department.

Forest Terminology with reference only to the more important terms.

By A. Smythies, B.A.

In accordance with a suggestion of Dr. Brandis, the remarks in the following paper will be confined to terms that relate to forest treatment, to different classes of forest, and to different classes of trees. Among these I have only taken what appear to me to be the most important, and I do not pretend for an instant that the list is an exhaustive one. A mere string of terms, without either an explanation of their meaning, or the reasons that prompted their suggestion, would not be of much use, so I have, in most cases, given what I trust will prove sufficient to shew in what sense the proposed terms have been employed.

Terms relating to Forest Treatment.

The first term that presents itself under this head is that of *working-plan*; other terms have been proposed in its place, one of them is *management-scheme*, and if any change were made, either this term, or still better *working-scheme*, might be employed. As far as I have been able to ascertain, two objections have been brought against the phrase working-plan, neither of which are very serious. The first is that people often mistake it for a plan or map, and talk of a working-plan on such a scale, two or four inches to the mile. No forester, however, would be likely to interpret the meaning thus, and if every member of the Forest Department understands what is meant by the term, our chief object will have been attained; and, secondly, when it has been finally recognised as a technical term and promulgated as such, then I do not think the term will be misunderstood even outside the Forest Department.

The other objection is, that the working-plan forms only a part of the whole scheme, or in the language of French Foresters, the "plan d'exploitation" forms but a small portion of the "projet d'aménagement;" here the plan d'exploitation would be a tabular statement, shewing the number of years in the rotation, the composition of the various blocks, the areas of the compartments forming those blocks, &c., in fact it shews, in

a brief form, that certain portions of the forest will be worked during certain epochs of a long rotation. It does not seem to me worth while to reserve the term working-plan, because at some future time we may want to apply it to a similar purpose. It is a term which is in daily use amongst us, which you see in almost every official report, and the meaning of which we at least all understand, and I think it would be a pity to change it; but if a change should be thought necessary, then use the term working-scheme in preference to management-scheme.

We have several other terms immediately connected with the working-plan. The first three or four are generally understood and employed. They are, 1st, *working-circle*, the area over which each working-plan extends its operations, or in case of several working-circles for one forest, the area to which each special part of the working-plan applies (for the general part might embrace the whole forest); 2nd, *block*, any convenient sub-division of the working-circle; and, 3rd, *compartment*, a still smaller sub-division, varying in size, but containing as nearly as may be a homogeneous crop or one that may become so within a reasonably short space of time; we then come to *rotation*; in the treatment of a regular High Forest, this would signify the number of years devoted to the gradual and successive regeneration of an entire working-circle, and in coppice treatment it would denote the length of the intervals at which the coppice was cut. This strict meaning of the term rotation it is most important to maintain; in which case we must absolutely refuse to recognise its application in any other sense, such as the opening of certain portions of forest to the public for a time, and then closing them for a while, the total number of years thus occupied forming what has hitherto been called a rotation.

The *period* is some aliquot part of the *rotation*, and in regular High Forest treatment, there are as many *blocks* in the working-circle as there are periods in the rotation, and in each successive period, one corresponding block is taken in hand and regenerated.

The last part of this sentence introduces a term connected with that portion of the subject upon which we are at present

engaged. We have various methods of working High Forest, and we require as many terms to represent these methods.

The natural method I would propose to call the method of *natural regeneration by seed;* I use the term regeneration as opposed to, and in preference to, *reproduction;* we use the term reproduction as a phenomenon by itself in a passive or inactive sense; I propose regeneration instead as denoting agency, the active intervention of the forester, who by a series of cuttings brings a new generation of trees on to the ground; he does not reproduce the forest; sometimes indeed his wish is to do almost anything but that; but he does desire to regenerate the forest, in the sense of bringing a new generation upon the ground; this seems to me a most legitimate destinction between the two.

In the method of natural regeneration by seed, there are two distinct kinds of cuttings. The first kind I would term *regeneration* cuttings; the second *improvement* cuttings.

Various names have been given to the three *regeneration* cuttings; collectively they have been called *serial* cuttings, which, in my opinion, is not so expressive a term as the one I have proposed, as it does not give the slightest clue to their object; the term *regeneration* cuttings *does;* individually, they have received various denominations, such as preparatory, light, definitive, clear, seed, seeding, &c. None of these are good, and some of them are positively wrong. The best terms that have hitherto been proposed are *primary* cutting, *secondary* cutting, and *final* cutting; defining the primary cutting as the one which is to effect the germination of the seed or, rather to establish on the ground of the coupe, the necessary conditions for germination to take place. This has been called the secondary cutting, but this is a term that we should reserve for that cutting or cuttings (as they are often more than one) which gradually admit the young plants to the beneficent influence of light, rain, dew, &c., reserving the term final cutting for the last one of all, when, as a rule, the remaining reserves are felled, and the crop of young seedlings is left to take care of itself. Thus we have the complete series of regeneration cuttings, *primary*, *secondary* and *final*.

The *improvement* cuttings may well be called *cleanings* and *thinnings*; *cleaning*, when the object is to get rid of obnoxious species that overtop and threaten the existence of more valuable trees; *thinning*, when dead and dying trees are removed, or those which are suppressed and will soon fade away and perish. The operation here termed a cleaning has also been called *weeding* and *clearing*; neither of these are admissible; weeding in itself is not bad, as it shews that the inferior species are removed by the operation, but we require the term weeding, for operations commonly known by that name, whether in the nursery, in plantations, or in the forest. *Clearing* must be restricted to the sense of clear-cutting, or clear felling.

Thinnings may vary in the quantity of produce cut out, and consequently we must distinguish between *light* thinnings, *moderate* thinnings, and *heavy* or *severe* thinnings; to *thin heavily* or *severely* is a well-known ordinary expression, and the best term to use in opposition to this is to *thin lightly*; when we perform an operation that in intensity comes between the two, we may say that we *thin moderately*. The other terms applied to thinnings that have come under my notice are ordinary, extraordinary, mean, average and slight, which are neither so definite nor so useful as the terms I have already mentioned.

Another method of working High Forest is what may be called the *selection system*, or to be in harmony with the one first mentioned, the *selection method*. This has been variously denominated selection felling, and cutting by selection; there is no doubt that you do fell or cut by selection, when treating forest on this method, but that is no name for the method itself. This is no place to enter into the merits or demerits of this or of any other system of treating forests, as what we are now concerned with is to arrive at some good definite terms to express different forest ideas, but there is no doubt whatever that this plan of cutting trees by selection is a well recognised, thoroughly understood system, that frequently has its "raison d' être," and in consequence we need not be afraid of giving it too much importance by adding the word method or *system* after the word selection.

With regard to felling operations, we must make a distinction between *felling* and *cutting;* the term *felling* I would restrict to the actual cutting down of the tree—of the individual, and not of the whole community of trees; thus in coppice, the way you arrange your *cutting* does not very much matter, but the manner of cutting has a most important influence on the well being and future development of the coppice. Here the idea is the individual cutting down of the trees, and the way in which it is done.

The term *cutting* is sufficiently explained by what has already been said on the method of natural regeneration by seed. But here again I would institute a distinction between the operation of cutting and the area or ground over which the cutting takes place; the French word for both is *coupe;* they talk, for instance, of numerous seedlings being found in such and such a "coupe" where the word coupe refers to a certain portion of the forest, and at the same time they talk of "coupes de regeneration, &c.;" for the word coupe as used in this sense, we have employed *cutting;* for the former sense we might retain the word *coupe*, and we should then be enabled to use such phrases as, "the year after the cutting took place, the coupe or the surface of the coupe was thickly studded with fine young seedlings;" or again, "the coupe exploited in 1875, is now covered by a dense growth of shrubs and grass." The French definition of the word *coupe* is a certain portion of forest destined to be cut as a whole or in part; it seems to me advisable to have two words, one to denote the area or portion of forest, another to denote the operation. Thus of the operation we could say an *open* or a *close cutting* had been made, according as many or few trees had been removed, while the result on the ground we might denote as a *light* or a *dark coupe;* as a further illustration we might say that a certain species required an open cutting, as its young plants would not prosper in or under a dark coupe.

The Different kinds of Forest.

The term *High Forest* is well known to all of us; its main object is to produce large-sized timber, and it is, as a rule, regenerated or reproduced by seed. It does not seem necessary

to call it High Timber Forest; the word timber here is *de trop*, as the definition of High Forest shows that the production of timber is implied. No other term has been proposed as far as I am aware for this kind of Forest, nor need we seek for a better one. High Forest may be *regular* or *irregular*; the former where the different age classes are well distributed over the forest, where the crop is complete, and where all the necessary elements for natural reproduction of the good species are to be found; the latter where the age classes are confusedly mixed. The selection system invariably results in an irregular High Forest; the natural method in a regular one

A *coppice* is a forest that is reproduced chiefly by means of shoots and suckers. We may have *simple coppice* where no *reserved* trees are left standing after the exploitation, or perhaps only a few left here and there as seed bearers; and *coppice with standards* where reserved trees, technically called standards, are left for one or more rotations of the underwood.

The latter has been called compound, composite, and mixed coppice; the term *mixed coppice* would refer rather to a forest where several species were growing together and is in opposition to *pure coppice*, which would consist of only one species; thus to take a few examples, an osier-bed is a *pure* coppice, and it is a *simple* coppice at the same time. A forest of this kind that contained nothing but teak, would be a *pure* coppice, and it would be *simple* or *with standards* according as no reserves were left or otherwise. If we had teak, dendia, saj, &c., growing together and no reserves were left, it would be a *simple* coppice, but it would not be a *pure* one; we should have to call it mixed. The term coppice under standards is almost identical with the one I have already mentioned, but I should prefer myself to see the preposition *with* used in preference to *under*; the latter might suggest the idea that the coppice grew up underneath the standards, which is not only not always the case, but is generally the exception. The former, *with*, shews that you have two distinct elements, the *coppice*, and the *standards*, and they are in fact, always looked upon as two separate items. There does not appear to me the slightest necessity for calling them *coppice forests*; the simpler we make our terminology the better; but

on the other hand, it is a mistake to suppose that forest "is too grand a term to apply to mere coppice." In the eye of the law, and in practice, in every-day use, a coppice is a forest just as much as High Forest, and you would, in a general way, make use of the term forest without stopping to inquire whether it was worked on the Coppice or High Forest treatment. The term *composite* may be passed over in silence, but *compound* deserves a short notice. As in contradistinction to *simple*, there is no doubt that *compound* is a good term, quite as good as *with standards;* but the latter deserves pre-eminence, as it elucidates the nature of the forest a little bit more, and the more intelligible our terms are in themselves the better.

The word *copse* should only be used as a verb, and not in the sense of coppice.

Under the head of Forest treatment a few other terms remain to be noticed. There is the verb to *exploit* and its derivatives, *exploitable, exploitation*, and *exploitability;* in regard to these I have nothing further to add to the remarks made last year by Mr. Pengelly; I would keep all four as being more convenient than other terms, which would of a necessity be more cumbersome. With regard to an allied word "possibility," which has its own meaning, I would suggest the term *capability*, to denote the quantity of material that can annually be extracted from a forest, on condition of taking out the same quantity year after year without exhausting the supply—without trenching on capital—what the forest on this condition is *capable* of yielding. The annual yield of the forest is not necessarily the same, though I suppose that is what is meant by *normal annual yield*. The term *capability* is slightly more intelligible than *possibility*, and either of them is more convenient than, if not so expressive as, *normal annual yield*.*

Different kinds of Trees.

We have two grand divisions of forest trees, and it is essential to have some uniform term to express the distinction. The best term that I have yet seen for the one class is

* Mr. Smythies evidently misunderstands the meaning of the term "*normal annual yield*," which is by no means identical with his "*capability*," but which means the quantity of material, that a forest would be capable of yielding, if it was *regular* in every respect.—The Editor.

that suggested by Mr. Pengelly, *viz.*, *broad-leaved species;* it will strike most of us as more appropriate than *leaf-bearing* trees, the only other term that I have met with in print—and it seems an especially good term for India where the leaves of many species of this class attain a considerable size. The other great division may be called *coniferous species*, or more shortly *conifers*.

Then with regard to the origin of forest trees, we may term *clump of shoots* the collection of shoots that spring up on the stool, after a tree has been cut down, *seedling*, the tree that proceeds from the direct germination of the seed, no matter what be its age, and we may call *seedling shoot* the tree that results from the cutting or burning down of a young seedling; most of the trees in tracts, regularly burnt by jungle fires, have originated thus.

When a forest is treated on the system of coppice with standards, we want terms to express the differences in age between the various standards; those reserved trees that are of the same age as the coppice may be called *1st class standards*, because they have passed through *one* rotation of the underwood; similarly, those of *two* rotations, *2nd class standards*, and so on. This will leave the expressions 1st, 2nd, 3rd, and 4th class *reserves* free for use, if necessary, in classifying the stock of a High Forest.

Terms relating to density of Forest.

We want a term to express a continuous state of dense growth of cover overhead—an equivalent for the technical French word "Massif." Mr. Pengelly has suggested the word "canopy," which is certainly better than the other terms I have met with, such as "close forest," "dense growth," "compact forest," &c. I would, however, slightly modify it and use "*leaf-canopy* instead, defining it as that state of forest in which the crowns of the trees touch each other without being swayed about by the wind. We may qualify the expression by the adjectives *dense*, referring to an exceedingly compact growth, and *broken* or *interrupted*, when the "leaf-canopy" has been very slightly opened out as after a close primary cutting; but if

much is cut out, the state of leaf-canopy ceases to exist, and we must employ such phrases as *opened out crop*, *open crop*, *open growth*.

It is obvious that we may have the state of *leaf-canopy* at all stages of growth, whether in the young seedling crop or in the mature forest, though the term would not be of much practical importance until after the final cutting.

At the same time we require different terms to express these various stages of growth. Taking the young seedling crop, we may say that it is in *the state of thicket* or *forms a thicket* when the trees still retain their branches down to the base.

The lower branches then begin to fall, and from this point until the trees have reached a certain size, either in diameter or in height, the crop may be said to be in the state of *saplings*. Whatever limit be taken for the sapling stage will denote the commencement of the next phase of growth, which may be termed *low poles*, or *small poles*. The succeeding stage may be denoted by the term *high poles*; this too would have its superior limit, and then the crop would attain the dignity of *high forest*.* Some such classification would, no doubt, be useful to us, but I refrain from suggesting what the limits of size should be for the various classes, though it seems to me that diameter and not height should determine them.

When there is no crop at all on the ground, most of us at present employ the word "Maidan;" there is no occasion to do this, as we have the word *blank*, which can always be qualified by such adjectives as extensive, small, &c., and if the blanks are very small, and surrounded by forest, we may use the word *glade*. In case the blanks occupied a very large area, I would term them *treeless wastes*.

The word "reboisement" has been frequently employed in reports, official documents, &c., but it seems to me that either *re-stocking* or *re-wooding* answer the purpose equally well; one point in their favour is that they are English words, and thoroughly express the required meaning; another point is that we shall then be able to employ the verbs to *re-stock* or to *re-wood*, whereas we cannot very well say to *reboise*.

* This term has already been disposed of.—The Editor

NOTE.

Some discussion took place at the Conference, and the following terms were generally agreed upon :—

Forest Treatment.

Working-plan.
Working circle.
Block.
Compartment.
Rotation.
Natural reproduction by seed.
Thinnings—light, moderate, heavy.
Cutting.
Area cut—the area in which fellings have gone on in a given period.

Different classes of Forest.

High Forest.
Coppice with standards.
Coppice.

Different kinds of trees.

Conifers.
Leaf trees.
Shoots.
Suckers.

The following definitions of the various age-classes were also given :—

Thicket—when the young plants have not yet begun to clear their lower branches.

Saplings—when the young plants separate, and the bole begins to clear.

Poles—when the sapling has grown to a large size, but is still growing vigorously in height.

Young (or middle-aged) trees—when the main growth in height has ceased, but the increase in girth is still proceeding vigorously.

Mature trees—when the growth in girth has ceased to be of importance.

The words *blank*, *glade*, and *large wastes* were also agreed upon.

With regard to the terms, *block* and *compartment*, the meaning given to them in the foregoing paper was not sanctioned; a full explanation of these terms will however appear in the forthcoming Forest Code.

With regard to a few other terms, no satisfactory understanding was arrived at by the Members of the Forest Conference. These terms will doubtless settle themselves in time, but meanwhile a discussion in the pages of the INDIAN FORESTER would not perhaps be entirely fruitless.

Sm.

On the relation between District and Forest Officers.

By C. F. AMERY.

AT the Forest Conference, recently held at Simla, one of our colleagues attempted, on more than one occasion, to lead up to the subject of the relation between district and forest officers, but speaking only out of the bitterness of his heart, and without due preparation, he succeeded only in eliciting from the President the severe rebuke that he, the President, should consider that officer unfitted for his position who was unable to get along with the district authorities.

So unqualified a remark is, it strikes me, calculated to do more harm than good. Excess of zeal is a far less serious and less permanent fault than indifference, and although a forest officer, who allows himself to be drawn into unseemly altercations with the district authorities on official matters, or who, when commenting upon difference of views between himself and his district officer, assumes the existence in the latter of a feeling hostile to the Forest Department, lays himself open to deserved censure, his error is far more deserving of condonation than that of the officer who voluntarily sacrifices the best interests of his Department for the sake of working smoothly with everybody, and Dr. Brandis' remark above cited is calculated to provoke to this latter policy those officers whose sense of duty is outweighed by considerations of personal interest.

There is, and probably for years to come there will be, an antagonism of view between the two departments—an antagonism based both on antagonism of interest and difference of stand-point. Up to a very few years ago the district officer held sole control of all lands in his district, and the unoccupied lands were his chief means of conferring patronage; he could give or lease them, or confer or confirm privileges in them. If troubled with lawless tribes of budmashes he could offer them land as an inducement to settle to honest pursuits, and if a keen *shikari*, the forests were his sole and undisputed game preserves. Apart too from all departmental and personal interests, his stand-point is different, his recollection carries him back to days when the forest as such yielded so little revenue, that it was often as well to let the people help themselves to its products and graze their cattle in it, as to be at the worry and cost of collecting the revenue; when every acre broken up for cultivation yielded more revenue than a hundred acres of forest land, besides enlarging the capabilities of the district, and promoting the well-being of the people; to a time, when in fact the amount of forest broken up for cultivation, became the recognised measure of a district officer's capability and tact. The Forest Department by breaking fresh ground have brought to light some new facts. They have discovered that while the fuel and timber-consuming population is rapidly increasing, the forest area under the control of the State has been, and is still being, so rapidly contracted that already far below the proportion to culturable land, considered necessary to the general well-being in other countries, which like India have no great wealth in coal and iron to fall back on, there is room to fear that the future prosperity of India is in danger of being retarded by a scarcity of forest products, which in their own degree are as essential to the general well-being as food and water. Even the so-called State reserves are hampered by village rights of diverse character. Not only are all the ancient rights concentrated in the now contracted forests, but the new settlers on that forest area, which has been broken up, claim to exercise rights in the forest area that remains.

The district officer is generally ready to support these claims, he conferred the rights, it may be only *viva voce* or along with a yearly tenancy, but having conferred them he will not see them wrested from the people by a new department, which he believes animated by no higher motive than a satisfactory balance sheet, and so the forest officer sees in the district officer a man willing to sacrifice the lasting well-being of the empire, rather than allow the people to suppose that he has ceased to be all powerful in his district, while the district officer, in his turn, regards the forest officer as full of crude and ill-digested notions, ignorant of, and indifferent to, the wants of the people, a clog to all true progress, and the cause of innumerable petitions and disputes.

Again the forest officer regards the exclusion of fires as absolutely essential to the well-being of the forests—he goes to considerable expense to keep out fires; the district officer tells him that he fears it will be no use—that the people have always been accustomed to fire them to improve the grass, or rather to bring on a young crop quickly—that it would be difficult to punish them for an act they saw no harm in—that in fact there was no harm in it—that there have been fires from time immemorial—and that the forest persists and will persist in spite of them. The forest officer knows better—he is zealous and energetic too, but in spite of this he wakes one morning to hear the fire crackling in the distance, and to see his forests all ablaze. Sallying forth promptly, he discovers a couple of cowherds coming from the direction of the fire, lighted hookahs in hand, and straightway hauls them before the Magistrate The accused deny the charge—there is no evidence, but the forest officers, and the Magistrate sums up shortly saying, that although a certain amount of suspicion attaches to the accused, there is no evidence that they fired the forest, still less that they fired it wilfully, and the case is dismissed. The forest officer, who has perhaps never been in a court before, takes exception to the verdict, is recommended to leave the court before rendering himself liable to punishment for contempt, goes home and writes an angrily-worded report to his chief, imputing improper motives to the district officer, thereby drawing down

upon himself a well-deserved *wigging*, and in the future is tempted to let matters take their own course, rather than earn a repetition of it.

But it will be said that with tact and temper the forest officer may always work well with the district officer. True, but he will not always carry his point. If the views gradually finding acceptance with the Forest Department are correct, district officers generally are not only not animated by them, but believe that they are wrong, and in this belief it is too much to expect that they should co-operate with us, nor can an appeal from the district officer be carried to higher authority, and won without causing a certain amount of unpleasantness, but a sense of duty should overrule all considerations of this nature.

There must be disagreement when there is honest diversity of opinion, and forest officers, if they have vision, and even insight, are but half articulate creatures, capable of crying out when they are opposed, but not generally capable of rendering intelligible the thing that they do see.

To place the forests again under the district officers would tend rapidly to smooth away the existing difficulties. Once more vested with sole authority over the land, and saddled with the sole responsibility of forest administration, they would subordinate their individual opinions to generally-recognised views of Forest Conservancy; fires, which cannot be kept out by the orders of the forest officer, supported by such assistance as he gets from the district officer, would cease directly the district officer ordered their discontinuance, and village rights ceasing to be a departmental question, would soon have their *status* defined, and be reduced to something like manageable proportions; but on many grounds, it would be inexpedient to take the forests out of the control of a specially-trained department, and we must simply wait patiently, until our infantile utterances have become sufficiently articulate sounds to make known to the highest authorities the things which we do see. Let us convince them that the tendency of our efforts is to secure the lasting well-being of the people, and we shall remove all obstacles to successful administration. The Government has been treated to too much speculative theory, and too

few hard facts, to warrant it in taking decisive measures for the rigid maintenance of the remaining forest reserves. Having convinced ourselves of the expediency of certain lines of conduct, we are endeavouring to give effect to them, while the Government remains but half convinced, and hence the support we receive when we come into collision with the district authorities is but half-hearted.

JJ. Reviews.

Report on Neilgherry Loranthaceous Parasitical Plants Destructive to exotic forest and fruit trees.

By George Bidie, M.D., Surgeon-Major, Superintendent, Government Central Museum, Madras.

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In almost all forests, there seems to be some great obstacle which has to be overcome before they can be placed on a proper footing. In the teak and sal forests generally that obstacle seems to be 'grass and the prevalence of jungle fires,' but in many cases, as in the Central Provinces, this obstacle has been fought against, with, at any rate, partial success. In the coniferous forests of the North-Western Himalaya the obstacle seems to lie in the destruction of seedlings by grazing owing to privileges enjoyed by the inhabitants of surrounding villages, but this being an artificial and not a natural obstacle is probably easier to encounter. In the babul forests of the banks of the Indus the shifting of the bed of that river and the uncertain state of safety of the forests, is the chief obstacle to the application of a continued working plan. Turning to plantations. In some parts of Scotland, notably Strathspey, the squirrels have multiplied to such an extent, and do so much harm to the young shoots of conifera as to make their destruction a matter of the first importance to the Foresters. In the larch forests too the ravages of dry rot, which have lately been so much discussed, but without result in the way of a preventive, have done incalculable damage, while, in India, we see our young toon trees eaten down year after year by insects, while we have but little means of preventing the damage without appliances too costly to be used. So it is with the valuable plantations of exotic trees in the Neilgherry Hills of the Madras Presidency, and the report before us treats of an obstacle, rather new in its way, *viz.*, the damage done by the epiphytic loranthaceæ to the trees.

The greater part of the report consists of a discussion on the species of Loranthus found on the trees of the Neilgherry plantations, and gives a list of the principal exotic trees upon which each species is found, which cannot fail to be interesting to the botanical student. We must, however, remark on the value of plates 3 to 9 as affording means in the ready identification of species. The subject of the system of propagation of the parasitical plant and its method of adapting to its own use the precis of its host is also discussed at length, but we can leave these discussions to a consideration of the points most important to the Forester, *viz.*, the nature of the damage done to the host by the parasite, and the best means of preventing this damage. The exotic trees, which seem chiefly to be attacked, are the *apple*, *pear* and *peach* and the *Acacia melanoxylon*. The *Eucalyptus globulus*, in whose welfare most of us seem to be interested, seems completely to escape, while the *Acacia dealbata* is only but slightly attacked. The reason for this preference, the author informs us, is, that while the bark of *Acacia melanoxylon* is rough and much cracked and consequently offers a safer resting place for seeds, that of the *Acacia dealbata* is comparatively smooth, and has less likelihood of the seeds attaching themselves. We should state that the seeds of the Loranthus are surrounded by a viscid substance which is either rubbed off by birds, who eat the outer covering of the fruit, rejecting the seeds, or which passes uninjured through their bodies, and so attaches itself to the tree.

With regard to the damage done by the parasites, Dr. Bidie states that their influence is not very marked unless they are large as compared with the size of the host, or unless the host is covered with such a number of them as to drain it almost completely of its sap. He says in para. 21: "The work of destruction proceeds as follows: One or more large branches get so covered with Loranthus that the whole, or nearly the whole, of the sap goes to the parasites, and thus the affected branches die of starvation, down to the trunk. Branch after branch perishes in this way, and at length the tree, bereft of its foliage and robbed of its sap, dies down to the root."

As to the effect on the timber Dr. Bidie says: "Although trees killed by parasites are quite useless as timber, the value as firewood is said not to be impaired. I am, however, doubtful on the latter point, and think it is one deserving of more particular inquiry and experiment. So far as my own experience goes as regards fir-timber, I know that trees that have died gradually of inanition, as parasite-affected trees in this country do, are comparatively worthless for fuel purposes." But the question, we may remark, here is: Would the trees ever be allowed gradually to die of inanition? Or would they not generally be cut before such a result took place? In the sal forests of the Sub-Himalayan tract we have often noticed large numbers of trees attacked by 'Loranthus,' but it never seemed to us that the wood was in any way unfitted for use, or that the trees gradually died of inanition. Such may however be the case, and may perhaps afford a clue to the reason of the prevalence of the large numbers of dry trees to be met with in the Northern Bengal sal forests; formerly this was put down to jungle fires, but lately it has been suggested that jungle fires are not always the cause of death; but only come afterwards and by clearing the tree give it the outward signs of having been killed by fire. This is a point deserving of further discussion. Turning to the means of preventing the ravages of these "Loranthi," we notice that in para. 30 Dr. Bidie discusses the question of excision of the part attacked. Excision however does not seem of much use, as we read that the stumped branches afford almost better resting places for the seeds than the bark of the tree itself, and so it seems more likely to increase rather than diminish the evil.

We cannot but regret that the report terminates so unsatisfactorily, and that the only definite remedy that Dr. Bidie can suggest, is to discontinue plantations of *Acacia melanoxylon*, as we consider it not yet satisfactorily settled that the Loranthi do sufficient damage to the tree as to render it unfit for firewood, when grown with a short term of rotation. We hope however that such an interesting subject will not drop, and that some forest officers may supply us with further informa-

tion on the subject, and especially with regard to *indigenous* trees, and among them our chief timbers,—the teak and the sal.

J. S. G.

Notes on Vanilla.

By Mr. O'Connor.

A pamphlet on the production of Vanilla by Mr. O'Connor has recently been issued from the Government Printing Press, Calcutta, which gives information on all the principal points of the culture and manufacture of this most valuable article, and certainly warrants the experiments which it recommends to be attempted in its cultivation in the Eastern and North-Eastern districts of India.

The pamphlet goes into the subject of the production of Vanilla at Bangalore, and contains an article published in 1861 in the journal of the Agri-Horticultural Society of India, and written by Monsieur de Floris of Reunion, giving full details of the cultivation and manufacture of Vanilla in the Isle of Bourbon, together with supplementary remarks on the same subject by Captain Lowther. The plant called Epidendron Vanilla is a creeper belonging to the family of orchids, and is a native of Central and of the warmer portions of South-America, from whence it has been introduced into various other countries, and especially into the Isle of Bourbon, where it has succeeded admirably, and now forms one of the principal articles of export. It might consequently, with all probability, be grown in the Andaman Islands, in Ceylon, and along the coasts of the Bay of Bengal, provided the spot chosen was sufficiently removed from the effects of the salt sea breezes.

The cultivation in India has been commenced in Bangalore under Colonel Buckle, and it has been found easy, and that the flowers fertilized freely, the artificial method of fertilization being indispensable.

It has even been introduced at Ootacamund where the plants flowered freely, but fruit has not been produced. A garden was opened out at Sibpoor on the Hooghly, but when the proprietor left the country, and sold his estate, it was allowed to go

into jungle. The plant has been known in Calcutta since 1835, and it has been grown in the Botanic Garden ever since, but owing to the ignorance of the need of artificial fertilization, as the insects of India have not yet appreciated its honey, it did not fruit at first. In 1855, however, fruit was produced, and owing to the favorable results obtained in Mysore, the Government of India has requested the Government of Bengal to resume its experimental cultivation in a thorough manner.

Mr. O'Connor anticipates success for the Vanilla in Assam, Burmah, and Lower Bengal, and considering the high value of the product, it should certainly receive a trial in different parts of these districts, as the extremes of average temperature do not vary more than in Bangalore, where good results have been obtained. As regards the commercial value of Vanilla, it is stated that the fruit, when prepared, has been used since the year 1720, as a flavoring essence and aromatic, especially for chocolate and cocoa.

Recently the pods which yield a fine brown color have come into demand for dyeing purposes in Germany, and this employment will give more strength and fixity to the trade.

The price obtained for good qualities of Vanilla is very high, and it is stated that good Mauritius pods were quoted last year at 80 to 90 shillings a pound, in the London market. As the price is now 25°/₀ above the average, it is evident that the demand is far beyond the supply.

That grown in Bangalore was only quoted at 10 shillings per lb., but this low price is attributed to the imperfect system of preparation owing to ignorance of the proper method, and profiting by experience it is hoped that Bangalore will produce as good Vanilla as Bourbon

In reporting on some pods produced in the Calcutta Botanic Garden in 1855, a leading firm of London confectioners estimated the value at 50 shillings per lb.

The Vanilla industry in Bourbon has attained large dimensions, and in 1871 nearly 40,000lbs were exported, being valued at £100,000.

In a report by Captain Lowther to the Agri-Horticultural Society of India in 1861, it is stated that a plantation of Vanilla

in Bourbon, of only one acre in extent, yielded 15,000 francs or 6,000 rupees in one year.

Much labor is not required in this industry, and ten laborers, whose services are not required throughout the year, are sufficient for the production of above 1,000lbs weight of the pods. As regards the cultivation in Assam, the Valleys and low Hills in Kamrup would be admirably adapted, and if natural forests were not preferred, large cuttings of several species of trees succeed at once, or plantations of rapidly growing trees can be formed from seed in one or two years, so that there would be no difficulty as regards the shading and supports.

A plant of Vanilla grown in Colonel Campbell's compound at Gauhati, in 1865, and clinging to a Kaddam tree, (*Nauclea cadamba*), attained to a height of 30 feet in two years and six months; it also flowered freely, and appeared most healthy. As the artificial method of fertilization was unknown, no fruit was formed, but Colonel Campbell states that the growth was most luxuriant, and quite unaffected by the cold, which in Gauhati attains a minimum of 44°.

The Kaddam would be admirably adapted for shade and support, and a seedling in Darang, only 4 months' old, attained a height of 15 feet 8 inches, with a girth at base of 9½ inches, so that no delay would be occasioned in getting up this necessary protection. The pan house system recommended by Mr. O'Connor would involve considerable expense both in construction and also in removal of the roof in case of rain, as the drip would certainly be prejudicial to the plants unless the roof were constantly removed during a heavy rainfall.

We await with interest the results of the experiments under progress in the Calcutta Botanic Garden, and can recommend Mr. O'Connor's pamphlet to the attentive study of our readers.

W. R. F.

III. Notes and Queries.

A few notes on the nursery treatment of Deodar, Chil, Chir, Ban, Horse Chestnut, Walnut and Alder, Acacia and Gum, by Mr. Craw, *Superintendent of Forest Nursery, Ranikhet.*

Deodar.—In this country Deodar is best sown soon after the seed ripens or early in December. The ground for seed beds should be light loam or what is termed good garden soil. Heavy clay soil, which binds in wet, and cracks under the hot sun of April and May, should be avoided. The grounds should not be manured—only carefully hoed 15 inches or 18 inches deep and levelled, and the seed sown in broad *shallow* drills 8 inches apart. Should the spring prove dry, the beds will require to be watered before the seed germinates, but this is not always necessary. When the seeds germinate and water is required, it is better to give a good copious watering once in two or three days than a little every evening, the good effects of which is quite nullified by the next day's sun. By July the young plants are sufficiently large to handle, and should then be transplanted in nursery lines, 9 inches apart and 6 inches in the lines. This work is best performed by stretching a line and cutting along it a trench with a hoe or a spade, and against the smooth surface of the bank (which should be as perpendicular as possible) thus formed, the young plants are placed and supported by a handful of earth, care being taken to first fully extend their roots against the bank. The remainder of the earth being then replaced and levelled. This is much better than transplanting by dibble, the hole made by which is ferquently too shallow, the roots are thereby curled up and the plant makes no progress.

By next rains the plants must again be transplanted in lines 15 inches apart and 1 foot in the lines, care being taken to remove them with a little ball of earth adhering to their roots.

The same care must be observed to fully extend their roots in the trench, and the ground should be pressed firmly about the roots to steady the plant. The plants soon establish themselves, and nothing further is required than to keep them free from weeds. By the following rains, the third year from sowing, the plants are ready for removal to the forests.

CHIL (*Pinus excelsa*).—The same treatment as for Deodar applies to this tree in the nursery.

CHIR (*Pinus longifolia*).—The seed of this tree does not ripen until March or April according to situation. Sow then and transplant as directed for Deodar.

BAN-OAK (*Quercus incana*).—Collect acorns early in December; gather from the tree, and not those that have fallen, which are generally worm-eaten. Any ordinary good soil prepared as directed for Deodar will suffice for the Oak. Sow like peas in broad drills a foot apart and 3 inches deep; keep free from weeds during the summer rains. During the *second* rains from sowing take up the young plants, lightly trim their roots, and transplant in lines 15 inches apart and 9 inches in the lines. Again weed and occasionally stir the surface of the soil, and during the following rains remove to the forest if the planting is near at hand; if very distant, again remove into nursery lines in rather poor soil, and transplant in the forests next rains. Oak succeeds best when transplanted during the rainy season.

HORSE CHESTNUT (*Pavia indica*).—Soon after the seed ripens, in November or December, sow in good rich soil in drills a foot apart, 3 or 4 inches deep, the seeds 6 inches apart. Keep free from weeds during the rains, and when the young trees shed their leaves in the cold weather take them up, lightly trim their roots, and transplant in good soil, in lines 18 inches apart and 1 foot in the lines. Occasionally stir the surface of the soil during the hot weather. No watering is required; keep free from weeds. In the cold weather the plants are fit for removal to the forest. They should be taken up without any earth adhering to their roots, which in the case of distant planting is a convenience and saving.

WALNUT (*Juglans regia*).—The same treatment of sowing, pruning the roots and transplanting, as directed for the Horse

Chestnut, applies to the Walnut. These trees, in fact all deciduous trees, are best transplanted during the cold weather.

ALDER (*Alnus nepalensis*).—This should be sown in the end of February or beginning of March in very shallow drills, a foot apart, on level ground. After sowing, the ground should be covered lightly with ferns or grass and watered occasionally until the seed germinates, after which gradually remove the covering and weed, water and stir the soil as directed for Deodar. During the following cold weather take up the seedlings, trim their roots with a sharp knife, and transplant in lines as directed for Horse Chestnuts and Walnuts. The plants, as in the case of Horse Chestnuts and Walnuts, are fit to remove to the forest the second cold weather from time of sowing.

ACACIA.—Choose a good friable soil, which, when dry, dig about 18 inches deep. If the land is not level, it should be formed into small terraces, according to the lie of the ground, and across the terraces make beds 4 feet wide with 18-inch paths between. Sow in fine weather, early in February, in shallow drills across the beds and 8 inches apart. If the weather proves dry, the beds must be well watered as directed for Deodar, and when the young plants appear they should be kept free from weeds and the soil between the drills frequently stirred with a small Dutch or draw-hoe. All watering, weeding, and hoeing should be performed from the paths and the beds not needlessly tred upon. By the middle of July, being then 6 inches to a foot high, the seedlings will be ready to transplant. Any ordinarily good ground, level or sloping, will do to transplant in, but care should be taken to avoid places subject to severe hoar frost. Take up the seedlings, line by line, with a digging fork, separate them into two sizes, and plant—the largest in one plot on lines 15 inches apart and 1 foot in the lines; the smaller plants put on another plot, on lines 1 foot apart and 9 inches in the lines, and afterwards keep free from weeds. By the following rains the plants will be ready to remove to the forests or plantations.

EUCALYPTUS.—Sow as directed for Acacias.

About the middle of July take up the seedlings, separate them into two sizes, and plant as directed for Acacias, and, as

in their case, also carefully avoid low damp places subject to severe hoar frost. Choose wet days for the work, and when the plants are established and weeds appear, hand-weed the lines, or, if a few fine days occur, first lightly hoe between the lines. Never allow weeds to over-top the plants, or they will be drawn up weakly, and be unable to withstand the winter without protection. By the following rains the plants will be ready to remove to the plantations. If the plants are required for very exposed situations, instead of sowing the seeds in February defer it till July, and then sow in sandy or gravelly soil, sloping gently to the east. Line off the beds across the slope, inclining a little one way for the paths to carry off heavy rain. The beds should not be level but sloping like the land and raised a few inches by means of the earth taken from the paths. Sow the seeds in very shallow drills across the beds, and when the young plants appear, keep them free from weeds. About Christmas, or when snow is apprehended, cover the beds with grass tatties, raised 18 inches from the beds. This covering should remain until the middle of February, or later if very cold and exposed. If the spring is dry, well water the beds three times a week, or oftener if necessary, occasionally stirring the soil between the drills to prevent its caking; and, when the rains set in, take up the seedlings, separate them into sizes, and plant as directed for spring-sown ones. Afterwards keep the plants free from weeds and remove to the plantations the following rains.

Unless the soil and situation are very favorable, the several kinds of gums should not be planted over 6,000 feet. Above this height they are liable to be broken by heavy snow lodging upon their tops and branches and weighing them to the ground. This year at Dunagiri, at an elevation of 6,500 feet, two large blue gums, 10 years old and over 60 feet high, were broken short above the ground by snow lodging upon them; younger plants of the same variety at a similar elevation at Ranikhet were also broken, while leafy plants of the same kind, five years old, at an elevation under 6,000 feet, escaped, their leaves being smaller and not so dense. Acacias are not so easily broken, and may therefore be planted at a slightly higher elevation than that

recommended for the gum; but care should be taken in planting either trees to avoid damp dells or flats subject to severe hoar frost. Of gums, the blue and iron bark (*Eucalyptus globulus* and *cideroxylon*) are the best sorts to plant in the hills; and of Acacias, *decurrens* and *melanoxylon*.

NAINI TAL; } G. GREIG,
The 2nd September 1875. } *Offg. Conservator of Forests, N. W. P*

Forest Fires.

It is interesting to observe in what light forest fires are looked upon in various parts of the world. Here is a case taken from a French paper, the *Journal du Loiret*.

In August last year an immense fire broke out in the forest of Orleans, and fanned by a strong southerly breeze spread rapidly in the direction of a village called Lorris. Forest guards, firemen gendarmes, and all the surrounding villages poured forth to the scene, and did their utmost to combat the raging element; but their united efforts were of little effect until the dew fell that evening, when the progress of the fire was to some extent checked. At Lorris the alarm bell rang all night, and the entire population turned and betook themselves to the scene of action. Next morning the fire increased in intensity, and assumed such a threatening aspect that they had to telegraph for assistance, and the fire-brigade of Gien and an officer of gendarmes set out immediately. Later on in the day the Prefet of the Loiret, accompanied by his Secretary, the Commandant of *Gendarmerie*, and an Inspector of Forests, set out from Orleans and took with them a detachment of 234 men from a Regiment of Artillery. These men remained all night on the spot, and, thanks to the energy and devotion displayed by all, both Military and Civilians, the flames were at length got under, and on the third morning when all danger was at an end, the Prefet and his Secretary returned to Orleans. We are told that an inquiry into the causes of this fearful disaster was immediately set on foot, and that the extent of forest injured by the fire was rather more than 1,000 acres.

SM.

The French Inundations and the Destruction of Forests.

In a very interesting paper contributed to the *Journal* of the Société des Agriculteurs, of which M. Drouyn de Lhuys is President, M. de la Gave, one of the Commissioners of Woods and Forest in France, insists upon the necessity of replanting the mountain slopes in the south of France, which have been almost denuded of timber within the last century. He begins by pointing out that the Pyrenean district was a hundred years ago altogether outside the agricultural and commercial movement of the country; the slopes of the mountains were covered with forests, which, owing to the absence of the means of transport, could not be made productive, while the vegetation on the summits was only available during the summer months for cattle and sheep, which were driven back into the valleys at the approach of winter. The low lands were poorly cultivated, the villages were built upon high ground, and the inundations were much less frequent, and, when they occurred, far less disastrous than at present. When better communications between this district and the rest of France were opened up, the value of cattle and sheep increased very considerably. Manure was required for fertilizing the soil, and there was a ready export for meat and wool. The forests were cut down in every direction, and the timber nearest the summits was removed in order to extend the pasturages. The slopes, thus denuded of wood, offered no obstacle to the flow of water, and were soon guttered in all directions. The southern slopes, upon which the vegetation is earliest and the cultivation consequently most profitable, were the first to be cleared, and it is upon them that the furrows are deepest. While this work of destruction was going on the marshes and water meadows, from which sprang the countless rivulets that formed the rivers of the district, were being drained. For while a few French rivers, such, for instance, as the Loiret and the Vaucluse, have their source in mountain springs, the larger number originate in rivulets fed by the rain and mist, which are almost perpetual in the mountain regions. To facilitate the flow of these tiny streams is to make a way for the inundations, while by checking their flow the water from the mountains, instead of pouring

down into the rivers in one vast volume, reaches them a little at a time.

The danger of inundations is to be diminished either by the construction of dams at various points in the stream, or by replanting the mountain slopes from which these streams are fed. The system of dams has been tried in the Alpine districts, but it is found that they are very liable to be choked up by the sand and stones which the water brings down with it, and in the course of a few years they become almost useless. Forests, upon the other hand, do their work much more effectually, for the soil, always covered with a layer of mould and leaves, acts like a sponge, and absorbs enormous quantities of water, which is afterwards thrown back into the atmosphere in the shape of vapor by the evaporation of the foliage. When this permeable soil is thoroughly saturated, the water, which cannot find its way down, trickles along the surface, but its progress is always being checked by the leaves, the moss, the trunks of trees, the underwood, and the broken branches with which the ground is strewn. However heavy the rainfall may be, there is never a regular current upon well-wooded ground. Moreover, the forests retard the melting of the snow, to which, more than to anything else, the inundations are due. M. de la Gave concludes, therefore, that if the inundations are to be stopped the mountain slopes of the Pyrenees, of the Alps, and of Auvergne must be replanted on a large scale.

After the inundations, which occurred in 1856, the Imperial Government took up a bill which had been framed ten years before, but which the Ministry of Louis Philippe had never made any serious effort to pass. This bill gave the Government power to expropriate the holders of any land which it was considered necessary in the public interest to replant, and an annual sum of £40,000 was set apart for this purpose. But when the Administration of Woods and Forests endeavoured to replant the summits of the Pyrenees and the Alps they met with great opposition from the inhabitants, or rather from the occupiers of the soil, who found their pasturages far more profitable. Their opposition, in fact, was so determined that the Government, anxious to carry out a useful work, but still

unwilling to make enemies, hit upon a compromise. This was to lay down fresh pastures instead of replanting, it being argued by many people that turf would absorb water as readily as trees. As might have been expected, the experiment did not answer, and it is now universally admitted that "réboisement" is the only effectual remedy. Whether the replanting of timber, no matter on how large a scale, will suffice to prevent inundations, such as those of last June, when seven thousand million cubic feet (six and a half milliards) of water were poured into a single river in the space of forty-eight hours, may well be doubted, and human effort will never probably render the land in the basin of such rivers as the Garonne, the Loire, and the Allier altogether secure; but much may be done to minimize their overflow and the disasters which ensue. The official estimate of the damage done by the recent inundations is 75,000,000 f. (£3,000,000). This sum would have sufficed to replant more than 100,000 acres of land upon the banks of the Garonne and its confluents, and such a quantity of woodland, even after only a few years' growth, would have kept back the rain which fell during the three days of June long enough to have limited the inundations within a comparatively narrow compass. The French Minister of Public Works has announced his intention of organizing a system by which the inhabitants of the land near these rivers may be warned when they are about to rise; but though this information will help to ensure personal safety, it will do nothing to keep back the waters.—*Pall Mall Budget.*

Climatic changes in Russia.

The following notes are taken from an article by Professor Palingsestow "on the climatic changes observable in Russia:" The winters, he says, are getting rougher every year; the summers hotter, drier and more sterile. In Bokhara and Taschkend the people say that the Russians brought the severe winters from their home, and in 19 districts the harvest reports are unfavorable, and even bad. The origin of these climatic changes Palingsestow proves to be the cutting down of the forests. Former-

ly large forests existed all over South Russia, which have now disappeared owing to this destruction of forests; the evaporation of the water is considerably increased, hence many once important Russian streams consist now only of swampy pools, or they are dry altogether. The Dnieper is becoming more shallow every year; his feeders Sula Psiol and Worskla can no longer be called rivers.

The planting of new forests has, therefore, been discussed for years past, but when the soil has once become so dried up, as in many parts of South Russia, such an enterprise is not easily carried into effect. During the last year, however, the matter have been considered very seriously, and it is to be hoped with good results.

Sw.

Kalakhambas.

Kalakhambas are the dead and partially burnt, or rather blackened, trees so often met with in Sal forests. A Kalakhamba is a tree that died in the full vigour of its growth, not one that died of old age. Kalakhambas attain a good height and considerable girth; the timber is chiefly used for posts: it is said to be more brittle but harder (being well seasoned), than ordinary Sal.

Its market value is ⅔ to 2 of good Sal timber. The formation of Kalakhambas is to some extent due to jungle fires, which cause the death of the trees by burning the bark and impeding the circulation of the sap; kalakhambas thus formed have generally many defects, being often hollow or partly decayed.

The chief cause of the formation of Kalakhambas seems, however, to be the quality of the soil. Heavy soil generally produces the greatest number by preventing the formation of lateral roots. The tap root pierces the clay, which is 3 to 4 feet in depth, and continues growing till an impervious stratum is encountered; the tree then dies off very suddenly. The longitudinal growth of the tree appears to correspond with that of the tap root, and is often very considerable.

The withering of one of the top branches, and the formation

of water shoots along the trunk of the tree, are the symptoms preceding the sudden collapse of all vitality in the tree. In the Dooars large tracts are sometimes found covered with small trees and Kalakhambas.

It is noticeable that Kalakhambas are almost unknown in the hills where the formation of lateral roots is very great and jungle fires rare. In the neighbouring Darjeeling Terai, where the soil is more sandy and loose, Kalakhambas are almost unknown, although the jungle fires are very frequent.

The revenue on Kalakhambas in the Julpigori Division exceeded Rs. 5,000 during 1874-75, and is capable of considerable expansion, if the supply lasts.

E. F.

"Sorghum Saccaratum."

I read an account a short time ago in a book of the introduction of the above named plant into South Europe and the United States of America, and of the remarkable manner in which it has thriven in the latter country especially. I will first give a short account of it, extracted from the work I have mentioned. "A sugar-yielding grass has lately been introduced into the south of Europe and North America, the cultivation of which has extended with wonderful rapidity in the United States *in regions far to the north of those adapted to the sugarcane*. It has long been cultivated in China and in Africa, partly for the sake of the sugar, which is made from it; and partly for its seeds, which are a good grain, similar to the "Durra," so extensively cultivated in the East Indies and Africa. Durra (*Sorghum vulgare*), also known as Sorgho and Indian Millet may also be said to be the principal corn-plant of Africa, and the sugar grass or shaloo (*Sorghum sacc.*) may be regarded as a superior kind of Durra. Its seeds are much larger than those of the common kind of Millet, and although the meal does not make good bread, it is very nutritious and pleasant. Its productiveness exceeds that of most kinds of corn, almost rivalling the productiveness of maize. It is a tall grass, from four to eight feet high, with a diffuse and very spreading

panicle. As a corn-plant, however, no attention has yet been paid to it either in Europe or America; whilst, as a sugar-yielding plant, it has obtained an important place in agriculture."

From the above I think it would thrive well in the hills; and it is my wish, if I can only procure some of the seed to introduce it into Bussahir, where no sugar of any kind can be procured. The seed should be sown as soon after the frosts have disappeared as possible, in rows about 4′ apart, and the plants thinned out to about 12″ to 18″ in the rows. In its infancy it grows very slowly, so great care must be taken not to allow weeds to choke it; afterwards it grows very rapidly. In America 100,000 acres yielded 16,000,000 gallons of syrup. Although a perennial, owing to the intense cold during the winter months that prevails in the Hills, I think it will have to be treated as an annual.

In conclusion, I sincerely hope that Government will take the matter up, as it is well worth its consideration, and allow us to give it a fair trial.

C. E. TENDALL,
S. A. C.

On the Killing of Trees.

WITH reference to the reply of M. H. F. to W. J. S. in your number for October 1875, a botanical friend of mine writes to me as follows:—

"Is it not generally taught in lecture rooms and in treatises "on botany that scalariform tissue is characteristic only of the "higher division of acotyledons, *i.e.*, ferns and their allies.

"Has M. H. F. made a discovery in anatomical botany? "or is he merely using scientific terms in a loose manner?

"His remark about the diffusion of the 'hyrocarbons' "is equally loose, and the term itself is misleading. The "gums, resins, starches, oils, &c., are *only* secreted after the "lungs and stomach of the plant (that is the leaves) have pre-"pared them for assimilation. The 'hyrocarbons,' if the "term be admissible, are not pumped out of the earth in a

"pure state as M. H. F. would appear to suppose. For refer-
"ences on the subject of scalariform tissue, see Professor
"Balfour's last Edition (1870) p. 321: 'Scalariform vessels are
"characteristic of fern structure;' and p. 714, 'Scalariform
"vessels are met with in the higher division of acotyledonous
"plants particularly in ferns.' See also Manual of Botany
"by Dr. R. Brown, 1874, p. 49: 'Scalariform tissue is charac-
"teristic of both the *aerial* and *underground* stems of ferns.'"

F. B.

Chinese Blackwood in Bombay.

At page 52 of the *Indian Forester* B. H. B. P. asks what species of tree is indicated by the name of Chinese Blackwood, and how seed can be obtained. I cannot state the correct botanical name of the tree referred to. I can tell, however, how it acquired the name of Chinese Blackwood. The tree, or rather shrub—for it does not appear to grow beyond 12 or 15 feet in height, and has several stems—was several years ago brought to Dharwar by the then Collector, Mr. Law, a well-known botanist. He obtained the seed of the tree from China. I know nothing of botany, but have always taken a great interest in tree planting. When I came to Dharwar I noticed several of these trees; they are rather handsome when in flower. I inquired the name, and was told it was a Blackwood obtained by Mr. Law from China. From that day it went by the name of the "Chinese Blackwood." Four years ago, finding two of these trees occupied a portion of grass ground on which I desired to plant some fine trees, I had them cut down and the main roots removed. Ever since then they have been a continual trouble and nuisance. Young plants from the old roots spring up in every direction, no matter how hard or bad the soil. Still up they come as soon as the rain falls. I have removed hundreds, and there they are again this year as plentiful, if not more plentiful, than ever. They seem to thrive in hard gravel or anywhere. It appears to me that if only 8 or 10 of these trees were planted to an acre, and then when about 6 feet high cut down, there would in a few years be a thick scrub jungle

yielding plenty of excellent firewood. Bare hills could be replanted with this shrub and in many places it would be a blessing to the people affording an ample supply of firewood and doubtless benefitting the rainfall.

If B. H. B. P. will give me his address I shall be happy to send him a supply of the seed.* I have never tried this shrub in good soil, but there perhaps it might grow into a large tree.

E. P. ROBERTSON, Bom. c.s.

* B. H. B. P. is at present on leave in England, but he will doubtlessly see this communication.—*The Editor.*

IV. SHIKAR AND TRAVEL.

Witchcraft in Bengal.

From time to time articles appear in different Magazines on the lingering belief in witchcraft in some of the remote parts of England. As a contrast between such superstition in the very centre of civilization, and the effects of this belief among an ignorant and uncivilised people, an account of some facts which occurred in Manbhoom, a non-regulation district of Bengal, where I at the time was living, may be of interest. Manbhoom is in the Chota Nagpore Division, and what I am about to relate took place within 300 miles of Calcutta. In 1864 fever of a bad type broke out in Patcomb, a pergunnah in the south-east corner of Manbhoom. The inhabitants of this tract of country are mostly of aboriginal tribes. They are, as may be expected, very ignorant and steeped in superstition. The belief in witchcraft is general, and all calamities happening among them, are at once attributed to supernatural agency. This outbreak of fever was of course put down to witchcraft, and the usual steps were taken to discover the witch or wizard whose work it was.

Witch doctors, called Ojahs or Sokahs, are the witch-finders. These men are not supposed to be themselves wizards, but are rather looked on as medicinemen, blessed with the power of divination, having some slight acquaintance with the properties of different herbs; they are also the representatives of medical science in these jungly regions.

Witches are not supposed to be in league with our devil of European notoriety, but each witch and wizard has his own special evil spirits, under whose influence she, or he, acts. The bulk of the people in these parts are Bhomiges and Sonthals, and their only religion, if so it can be called, is the propitiation of evil spirits. Independants of the spirits who arbitrarily taking possession of men or women, bring on them the unenviable distinction of being known as wizards or witches. There is

hardly a village which has not its own special Bhoot, or evil spirit which has constantly to be propitiated. Such Bhoots are generally residents in some tree in or near the village, but are often supposed to be in groves far from the village itself.

As a proof of the extent to which the belief in the agency of these Bhoots is carried, I may mention that one day, when riding out shooting, I passed a fine old peepul tree; the men who were with me, as I drew near to it, rushed up, and with clasped hands entreated me to get off my horse and walk quietly past the tree, as the insult I should offer to their Bhoot, were I to ride past his abode, would inevitably arouse his anger and bring about some evil!

The Ojahs or Sokahs have several methods to which they resort in finding out witches. The two following are however the most common.

One is for the suspected people, popular suspicion often facilitating the doctor's work, to be collected together. The Ojah then takes a white peeled stick and plants it erect in the ground a few yards from him. After having gone through various incantations, he takes a bow and arrow, and shooting at the white stick, calls out, as he fires each arrow, the name of one of those suspected, the stick being hit by one of the arrows, the person whose name was called out as that arrow was being fired, is at once known to be the witch or wizard. There can be little wonder at the respect shown to these Ojahs when they hold such a powerful engine for revenge in their hands!

The other method is for all the neighbouring villages to be collected together at some spot set apart for such social gatherings. Two or more Ojahs are generally present, and sit in the centre of a circle composed of all those assembled. Certain ceremonies and incantations are then gone through by these witch-finders, and they sing wild songs to the noisy music of tom-toms or drums of various sizes and descriptions. As the noise increases, louder grow the songs, and, gradually working themselves into a frenzy, up spring the Ojahs and commence a regular devil dance. Wrought to a pitch of excitement, in which the assembled crowd partake, the Ojahs now call on the bewitched to step out of the circle and join in their dance, and

ere long some one wild with excitement jumps up and joins them. It must be an irresistible impulse, which induces any one to do this, as they well know, that be it man or woman, young or old, he or she stands self-convicted as the witch or wizard who is being sought for, and that the consequences of such avowal on their part may be death.

The witch or wizard being thus detected never or seldom denies the charge of being such, and steps are at once taken, varying according to the circumstances which have rendered them necessary to appease the evil spirits of the bewitched, or take vengeance for the mischief he or she may have done. In some cases nothing but the death of the witch or wizard will satisfy the people; in others a fine is sufficient; then the witch or wizard has at once to pay up, and poojah being done to propitiate the Bhoot, a general feast follows.

In the case of which I write, the dancing method of detection was that employed by Chamoo, the chief Ojah present. Chamoo agreed that if he did not point out the witch he would forfeit 10 rupees, but that if he did, he was to receive 10 rupees for his trouble. A very safe agreement as far as he was concerned! Chamoo accordingly performed his incantations, sang his songs and danced his devil dances. Until a woman, named Sokri, stepping forth from the surrounding circle of villagers, joined in the dance and loudly proclaimed that she was a witch. She did not however claim this distinction alone. She sang out as she threaded her frenzied and fatal dance, the names of three of her relatives who were present proclaiming them to be her sister witches. Apparently nothing lothe, the three named—Pemi, Prengi, and Gooroobarri sprang up, dashed into the centre of the ring, and wildly dancing joined in their self-accusation.

"The weird sister, hand in hand."

* * * * *

"Thus do go about, about."

And well might their chorus have been—

"Double, double, toil and trouble,"

for great was the trouble before them.

After this these four poor deluded women were made to pay a fine, poojah was done to avert the anger of the evil spirits,

and the fever shortly after disappearing, the whole business was considered to have been most satisfactory. Chamoo got his 10 rupees, all parties were contented, only the "weird sisters," Sokri, Pemi, Prengi, and Gooroobarri, retained the dread reputation of being witches—a reputation certain sooner or latter to bring about them "toil and trouble." In November 1865 cholera broke out in this part of the district, and the son of Beenund Naik, headman of a small village, was taken ill. Phowd was Beenund's eldest son, for whom he seems to have had a deep and special love, and to see his first born stricken with a deadly sickness, caused him terrible grief. In his despair he thought of the witch Sokri, and arguing that she who could cause could also avert evil, determined to apply to her to cure his son. Sokri and her sister witches happened to be Beenund's near relations. Sokri was his niece by marriage, Pemi and Prengi his nieces, and Gooroobari his own sister. He sent for Sokri, and she came to his house. The remainder of this strange story I cannot give better than in Beenund's own words, as he told it to me in Court.

"Sokri," he said, "came to see Phowd and gave him a pill, after taking which he was a little better. She then told me to call in Pemi, Prengi and Gooroobari, that the four of them together could cure my son, but that she alone could not do it. I called them, and they came to my house, and saw my son: he was then very restless and had much fever; they said that he had "Soothia," and that I was to go to Unund Bhomige in Kanchera village; he is a Sokah, (Ojah or witch-finder), and to get medicine from him, and that my son would recover."

"I went to him myself, leaving the four with my son; he gave me a pill; his house is about ½ coss (½ mile) from mine. I returned at once and gave it to my sister Gooroobari, and she gave it to my son. They said that he would now recover, he took the pill and by morning my son was dead; it was very early in the morn, when I went to Unund and daybreak when I got back; my son died about one hour after taking the pill."

"Then I said to the four women—why have you eaten my son?"

(In speaking of deaths caused by witchcrafts, the witch is always said to have eaten, not to have killed.)

"Why have you eaten my son, I have 8 head of buffaloe, why did you not eat half? I have 10 cows, why did you not eat five? If that would not do, why did you not eat me? If you had eaten me, you might have escaped with life, but you have eaten my son, it will be hard for you now to escape, as I will kill you. They said, 'then kill us.'"

In answer to a question I put, Beenund said, that the women did not cry, or make any noise, on hearing his intention to kill them, nor did they in any way attempt to repudiate the charge that they had killed Phowd; all they said was, "then kill us."

Beenund continued.

"I then told them to take my son's body to the river, and they took up the body as it lay on the charpoy, (a low kind of bed, wooden frame, with string work), and I followed them with my tulwar. When they had put the body down near the river, I said, 'now I will kill you, you have eaten my son!' They answered 'then kill us if we ate your son.' I then made them sit down in a line facing the east."

I could not get Beenund to explain why he made the women face the east, but it was evident that he attached great importance to this. He went on:—

"I first killed my sister, I gave her one blow on the neck with my tulwar, her head hung by the skin. I nearly cut it off, the others did not move or attempt to escape. I then killed Sokri. I hit her on the neck and her head was severed, all but the skin. I then killed the other two, Pemi first, then Prengi. "Prengi (who was the youngest of the four and only about 20 years of age)," went and crept under Phowd's charpoy. I said to her, that I had killed the other three, I would not save her, so when I told her to come out from under the charpoy, she came out and sat down again; she said that I must not kill her, that she had done nothing, but I killed her; I was angry at the time, but I think that I did well; they ate my son."

Beenund having thus beheaded the four witches, went off straight with his bloody tulwar in his hand to the nearest police

station, and there gave information of what he had done. A police officer going at once to the spot found on the banks of the river Soobunrecka Phowd's dead body lying on the charpoy, while near and in line lay the bodies of the four wretched women, each with the head, all but severed from the trunk.

Beenund was charged with the murder of these four women, and the words I quote are his when on trial. His answer to a question I put, as to whether he was aware that those who committed murder were hung, was strange and shows the spirit in which he acted, "yes I know he who kills, will be killed, but my other two sons will now live; had these women lived they would have eaten them too."

It was impossible not to pity Beenund; he was a fine tall white-headed old man, and he spoke of his love for his first-born Phowd with intense pathos. He knew that he had according to our law done wrong and merited death, but he willingly accepted all the consequences, satisfied that he had avenged his one son's death and had secured safety for the other two.

Beenund was hung, but he left this world convinced that he had done well in sending four witches out of it before him. In this belief his family fully sympathised; his wife Taroo said to me in court in answer to some questions:—

"The women consented to be killed, as they said that having destroyed our son they were ashamed to go to their homes. Since the witches were killed there has been no more cholera in our village. I think it's well that they were killed."

This is a plain story of witchcraft as to be found still in many parts of India. The action of the father maddened with grief at his favourite son's death, and believing implicitly that it was caused by the four so-called witches, one can understand, but it is difficult to understand the action of these women, who thus quietly accepted death without any attempts at self-preservation, accepted it too at the hands of an old man, they being comparatively young and active, from whom they could have escaped at once had they wished to do so. It only shows the length to which this old superstition drives people, and the strange influence it exercises over them, where there is nothing better to counteract it, when we find people willingly bearing the imputa-

tion of being witches, though knowing too well what such an imputation generally leads to, and willingly taking death as a fit punishment for what they must really have believed had been caused by their evil agency.

R. M.

Legendary.

How Ráni Kanwalapatí was cured of her vanity.

In days long ago the mighty Rájá Ben lived in his impregnable fortress of Singaurgarh, and from thence ruled a far and wide kingdom, little dreaming that in due time a beef-eating caste despising race of forest officers from the west would take up his fine old fort and make it part of their charge; for it is now in the Singrampur reserve of the Northern Division, Central Provinces.

This Rájá Ben had a wife called Kanwalapatí, whose virtue and goodness was such that she could walk on a lotus leaf without its sinking, and her beauty was equal to her virtue. Now though Kanwalapatí was far above ordinary women, she was still but a woman, and she on one evil day imagined that her peerless beauty would be set off, for enhanced it could not be, by jewellery. One of Kanwalapatí's principal virtues was being above the weaknesses of other women, but she fell into that snare into which so many of her charming sex do—a love of finery—and thus she proved herself mortal.

When Rájá Ben heard of the Ráni's desire he tried every argument he could think of to induce her to give up the idea, but failed, and at last in extremity said to her that if she would wear jewels she should wear those he gave her. Rather than go without she accepted his offer, and Rájá Ben collected all the pins from the ploughs of the Pergunnah of Singaurgarh, and making those into jewels he gave them to his wife, who put them on.

Having done so she essayed to walk on lotus leaves, but the first leaf she put foot on sank till the water came over her ankles, and then, fortunately not too late, were her eyes opened to her folly, and she cast off her jewellery, ordering it to be remade into pins and returned to the several owners. As she did so the gods who had been rightly angered at her succumbing to such a weak-

ness as love for finery, reinstated her in their good favor, and the lotus leaf again rose till it became erect, and the Ráni, light as a feather and tripping from leaf to leaf, became once more worthy of her name "Kanwalapatí."—

Apropos of this Ráni I picked up the following amusing doggrel.

Tal hai Bhopàl Ketal
Aur sab taleyán
Ráni haí Kanwalapatí
Aur sab gadheyán.

I would suggest forest officers collecting and sending to the *Forester* all such legends in connection with their forests, as they may pick up.

G. F.

The New Forest Exhibition.

This exhibition of paintings and drawings, illustrating the picturesque scenery of the New Forest, would well deserve recognition in a purely artistic sense. Its promoters have a special object in view in opening such an exhibition at the present time, but the notion of thus bringing together a number of views of a single district is a good one in itself. There is a peculiar satisfaction in studying the changing aspects of a region so rich in beauty as the New Forest, and in being able to compare and contrast different kinds of landscape united by certain broad general characteristics. The individuality of each artist leaves, it is true, a strong mark upon each picture, and aids the impression of variety in a collection like this; but in order to be assured that the forest itself is not wanting in variety, we have only to turn to a series of sketches by a single artist. Mr. W. Kümpel contributes nearly twenty views of different parts of the forest, which sufficiently establish the richness of its resources. These sketches, admirably executed in water colour, are entirely characteristic of the country they interpret, and we find no other work in the exhibition that so successfully presents the enchanting distances of softly undulating woodland which form a special feature in the scenery. For an idea of the grandeur of the woods themselves, we may select the finely

finished painting by Mr. Newton, where the splendid structure of the older trees and their spacious arrangement are powerfully realized. A like impression of grandeur in the gigantic materials of the foreground, with added glimpses of distant foliage seen through chance openings in the wood, is secured in the two views near Stoney Cross, by Mr. Chester; while for the influence of summer sunlight we may study Mr. Pain's careful and elaborate painting of a forest stream whose quiet waters perfectly mirror the rich greens of the leaves overhead and deep blue of the sky. The series of drawings executed by Mr. Walter Crane are also to be ranked among the interesting contributions to the exhibition. They present with rare fidelity the intricate forms of individual trees, and convey some idea of the vast resources of the forest for the purposes of artistic study.

But to those who know the forest itself even the best of these views will be little more than a faint reminiscence of its beauty. Great as it undoubtedly is as a subject of pictorial treatment, the New Forest is still greater in its delights as a pleasure ground to wander through again and again. No series of views, however perfect, can aptly image the loveliness of a region that shifts into new devices of beauty at each step taken, and the painters themselves, who have so generously contributed to this exhibition, would probably be the first to acknowledge the impossibility of transferring to canvas the influence of scenery so infinitely varied in its character. To take single scenes from a district like this is in fact to attempt to illustrate a drama by the selection of particular moments in the action. The scenery of the New Forest does not culminate in a few spots of exceptional charm and attraction, but is worth knowing throughout. There never was a district more entirely free from the reproach of monotony, and consequently it is of all districts the least susceptible of complete representation by means of art. We say this, of course, not to disparage the beauty of the pictures here collected, but only to show that the pictures can be no substitute for the forest itself. A tract of country of this rare order, which cannot be traversed without leaving a multitude of varying and beautiful images, is a possession that may be lost but not readily recovered, and we venture to think that the chief delight

it offers is not directly associated with its value as a subject of art. The best effect of the exhibition lately opened will, therefore, lie in the inducement it may offer to those who are still ignorant of the beauty of the forest to seek it out. To excite this interest and to arouse the public to a proper sense of the value of a possession that has already been much injured, has been the object of those by whom the exhibition has been promoted, and it is an object that needs support from every Englishman who cares for the pleasures of the country. For unless a powerful public protest is made it is clear that the New Forest will not be long left to us. At present the only monotonous and unbeautiful portions of the district are the large enclosures filled with thick plantations of Scotch fir. If the policy of the past is allowed to continue, the whole of the forest will speedily be reduced to this plight, and the few grand woods that remain, and which are not to be equalled by those of any other part of England, will be irrevocably lost. It is well under such circumstances that by the energy of individuals the progress of the work of destruction has been arrested for a while. But the efforts of these individuals need the support of the public, and now is the time when opinion strongly and generally expressed would arrest an act of vandalism. We believe that when the public realizes the magnitude of the loss with which they are threatened there will be no hesitation as to the course to be pursued, but the difficulty in such cases is to bring the right influence to bear at the right time. We cannot buy all that we can sell, and if we once part with the New Forest we shall find it hard to replace.—*Pall Mall Budget.*

Mountain Jottings.

THE following statistics regarding some of the principal mountain ranges in the world may be read with interest.

The heights of the best known sanitaria in India are as follows:—

Chini	9,096	feet above sea-level.
Ootacamund	7,490	" "
Simla	7,156	" "

Murree	6,963	feet above	sea-level.
Darjeeling	6,905	,,	,,
Mussooree	6,849	,,	,,
Nynee Tal	6,520	,,	,,
Nurelia (Ceylon) ...	6,218	,,	,,
Kunnoor	5,960	,,	,,
Mahabuleshwar... ...	4,500	,,	,,
Cherra Poonjee	4,125	,,	,,

No less than forty-five peaks in High Asia are known to be higher than any in the Andes or elsewhere in the world. The highest mountain in the Himalayas, and in the world, is Gouri Sunkur, or Mount Everest, in Nepal, which is 29,002 feet; the second is Dapsang, in the Karakorum range, which is 28,278 feet; and the third is Kinchinjunga, which is 28,156 feet. The highest point ever reached by mountaineers is believed to have been attained by the brothers Schlagentweit, who, on the 19th August 1855, ascended Ibi Gamin, in the Karakorum Himalayas, a height of 22,259 feet. From the 13th to the 23rd August 1855 the brothers Schlagentweit were encamped on the Ibi Gamin glaciers, their lowest camp being at an elevation of 16,642 feet, and their highest camp being 19,326 feet above the level of the sea. On one of these days they crossed the Ibi Gamin Pass, of which the height was registered at 20,459 feet; and, on another, the Umtagh Pass, which is 19,629 feet. The Parang Pass, in Spiti, the highest point of which is 18,500 feet, is believed to be the highest Pass that is regularly crossed for purposes of commerce.

The highest peak in the Andes is Aconcagua, 23,004 feet, and there are five peaks in the Andes higher than Chimborazo, which is 21,442 feet. In the year 1802 the eminent Humboldt reached a height of 19,286 feet on Chimborazo; and in 1831, Boussingault reached a height of 19,695 feet on the same mountain.

The highest peak in the Caucasian range, the Kasbek mountain, which is 16,500 feet high, was ascended in 1867 by Mr. Douglas Freshfield and his party. The highest peaks in the Alps are Mont Blanc, 15,784 feet, and Mont Rosa, 15,223 feet: these are now frequently ascended every year. Mont Blanc was first ascended by Jacques Balmat in 1786. Ben Nevis in Scot-

land is 4,406 feet in height, and Snowdon in Wales is 3,590 feet.

Le, the capital of Ladakh, is 11,257 feet above the level of the sea. The highest permanently inhabited localities in the world are the Boodhist monasteries in Thibet. There is a monastery at Hanle, in Ladakh, 15,117 feet above sea-level, where there are twenty lamas; and there are others about the same height around the Lakes Mansarowar and Rakur. The St. Bernard Monastery in the Alps is 8,114 feet high.

Snow-fall in India Proper has never been recorded; not even sporadically on Dodabetta in the Nilgherries, which is 8,640 feet high. In the Himalayas snow has fallen in localities as low as 2,500 feet, but 6,000 feet may be assigned as the limit where snow regularly falls and may remain a short time on the ground. The limit of perpetual snow on the southern slopes of the Himalayas may be stated at 16,200 feet, and on the northern slopes at 17,400 feet. In the Karakorum range the snow line on the southern slopes is 19,400 feet; on the northern slopes 18,600 feet. In the Swiss Alps the southern snow line is 9,700 feet, and the northern snow line is 8,900 feet. The extreme line of perpetual snow is near the Mont Blanc and Mont Rosa groups, where the snow line is 9,800 feet.

In the Himalayas the lowest glaciers descend to 11,000, and even to 10,500, feet. In the Andes no glaciers are known to exist. In the Alps the lowest glacier is the well-known Unter Grindelwald, which reaches down to 3,290 feet; but in general 5,000 feet must be considered as rather a low end of a glacier.

In the Himalayas trees grow up to a height of 11,800 feet, and there are often forests just below this line. In the Andes the growth of trees ends at 12,130 feet; in the Alps it ends on an average at 6,400 feet, but it is stated that specimens of trees are found above 7,000 feet. In the Himalayas there is no grass vegetation above 15,400 feet; but the pasture grounds in Thibet are known to extend over an elevation of from 15,000 to 16,350 feet.

Monkeys are frequent in the Himalayas at heights not exceeding 11,000 feet. Tigers have been found up to 11,000, and leopards up to 13,000 and 14,000 feet. Fishes have been found

in small rivulets of Thibet at a height of upwards of 15,000 feet. In the Alps fishes have been found at an elevation of 7,000 feet, but not beyond; and it has been found impossible to acclimatize them at the St. Bernard Monastery, 8,114 feet above sea level.—*The Statistical Reporter.*

"A bas les Mosquitos."

A tincture of 1 part of insect powder, 2 parts of alcohol and 2 parts of water protects all parts of the body, which are wetted with it, absolutely against any attacks by mosquitos. On the Siamese rivers, which enjoy such bad repute as regards their mosquitos, Dr. Jagor often slept quite unprotected, except by the above tincture, without being in the least molested. The humming of these insects, which otherwise drives away all sleep, became quite harmless music. In the same way a single wetting of beard and hands protects the hunter in swampy ground against mosquitos for 12 hours.—*Jagor's Reiseskizzen, p.* 120.

S. K.

V. EXTRACTS FROM THE OFFICIAL GAZETTES.

2.—CALCUTTA GAZETTE—

The 11th November 1875.—*Mr. F. O. Lemarchand,* Assistant Conservator of Forests, 2nd Grade, is posted to the Chittagong Forest Division.

Mr. W. Johnston, Assistant Conservator of Forests, 3rd Grade, in charge of the Palamow Forest Division, will be attached to the Office of the Conservator of Forests, Bengal, on being relieved of his present duties by Mr. G. A. Richardson.

Mr. G. A. Richardson, Sub-Assistant Conservator of Forests, is appointed to have charge of the Palamow Forest Division, *vice* Mr. W. Johnston.

The 21st December 1875.—The orders of the 11th November 1875, published in the *Calcutta Gazette* of the 24th idem, posting *Mr. F. O. Lemarchand,* Assistant Conservator of Forests, 2nd Grade, to the Chittagong Forest Division, are cancelled.

Mr. J. C. McDonell, Assistant Conservator of Forests, 1st Grade, is appointed to have charge of the Julpigoree Forest Division.

Mr. E. Fuchs, Assistant Conservator of Forests, 3rd Grade, is appointed to have charge of the Buxa Sub-Division.

3.—NORTH WESTERN PROVINCES' GAZETTE—

The 19th October 1875.—No. 209 F. C.—In supersession of Notification No. 175 F. C. of the 16th ultimo, three months' privilege leave of absence is granted to *Mr. G. A. Down,* Sub-Assistant Conservator of Forests, with effect from such date as he may avail himself of the same.

The 5th November 1875.—No. 254 F.—Leave without pay for two months and twenty-one days is granted to *Mr. A. K. Grant,* Assistant Conservator of Forests, 2nd

Grade, in extension of leave granted to him in Notification No. 22 F., dated 30th June 1874.

This cancels Notification No. 216 F. C, dated 26th October 1874.

The 20th November 1875.—No. 264 F.—*Mr. G. A. Down*, Sub-Assistant Conservator of Forests, availed himself on the 2nd November of the privilege leave granted to him in Notification No. 209 F.C., dated 19th October 1875.

The 2nd December 1875.—No. 287 F.—*Mr. R. P. Colvin*, Deputy Conservator of Forests, 1st Grade, has been granted by the Right Hon'ble the Secretary of State for India a further extension of two months' leave of absence on medical certificate, in addition to that granted to him in Notification No. 191 F., dated 21st July last.

The 10th December 1875.—No. 294 F.— The one month's privilege leave of absence granted to *Mr. O. Greig*, Sub-Assistant Conservator, in G. O. No. 131 F., dated 19th July 1875, is hereby cancelled.

The 14th December 1875.—No. 297 F.—Privilege leave of absence for two months is granted to *Mr. C. W. Palmer*, Sub-Assistant Conservator, with effect from 1st December 1875, or from such subsequent date as he may avail himself thereof.

6.—CENTRAL PROVINCES GAZETTE—

The 14th December 1875.—No. 4493.—*Mr. W. P. Thomas*, Assistant Conservator of Forests, returned from the privilege leave granted to him by Notification No. 2038, dated 10th June last, and assumed charge of his duties on the 23rd October last.

7.—BRITISH BURMAH GAZETTE—

The 14th October 1875.—No. 107.—*Mr. A. E. Wild*, Assistant Conservator of Forests in British Burmah, is promoted from the 2nd to officiate in the 1st Grade, with effect from the 1st April 1875.

No. 108.—*Mr. G. A. Watters*, Assistant Conservator of Forests in British Burmah, is promoted from the 3rd to the 2nd Grade, with effect from the 1st April 1875.

8.—BOMBAY GAZETTE—

The 12th October 1875.—*Mr. H. Barrett,* Deputy Conservator of Forests, 2nd Grade, is promoted to the 1st Grade, with effect from the 18th July 1874

The 21st October 1875.—*Mr. Mainwaring,* Assistant Conservator of Forests, passed an examination in Marathi on the 11th instant.

The 21st October 1875.—*Mr. W. G. Betham,* Assistant Conservator of Forests, Dharwar, delivered over the charge of his office to the Conservator of Forests, Southern Division, on Saturday the 16th instant, after office hours, and reported his departure at the same time for Poona to appear there before the Committee of Examination, ordered in Government Resolution No. 5196, dated 11th September 1875.

The 26th October 1875.—*Mr. W. G. Betham,* Assistant Conservator of Forests, passed an examination in Kanarese on the 20th ultimo.

The 23rd November 1875.—*Mr. J. M. Campbell,* Conservator of Forests in Sind, having returned to Bombay on the 18th instant from the six months' special leave granted to him in May last, the unexpired portion thereof is cancelled, and he is allowed subsidiary leave for a period, not exceeding thirty days, to enable him to join his appointment.

The 1st December 1875.—*Messrs. J. L. Laird* and *R. B. Oliphant,* Assistant Conservators of Forests, Belgaum, delivered over and assumed charge of the office of the Assistant Conservator of Forests, Belgaum, on the 17th November 1875, before office hours.

INDIAN FORESTER.

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Bamboo and its use.

By S. Kurz.

(*Continued from Vol. I., No. 3, page 269.*)

III. Species of Bamboo.

Col. Munro, in the 26th volume of the Linnean Transactions, has published a monograph of all the bamboos known to him. Previously to him, in 1839, Prof. Ruprecht, in the Transactions of the Academy of St. Petersburg (Ser. VI., vol. V., part 2) has furnished us with an admirable account of the bamboos. These two works form now the foundation of all systematic work in bamboos. My own studies of this group were commenced in the Botanic Gardens, Buitenzorg (Java) many years ago; but owing to the difficulties I have experienced in procuring the different species of bamboos growing in British India, and owing to my desire of studying them all in nature instead from dried specimens only, I have thought it necessary that I should for the present treat only the bamboo of those countries of which I have the best material for study at hand. These are chiefly the bamboos of the Malayan countries, of which such a fine living collection exists in the noble Botanical Gardens of Java. At the same time I may be allowed to acknowledge the obligations under which I stand to Mr. J. E. Teysmann, the late Director of the Java Gardens, and at present Honorary Inspector of Cultures, to whose energy and disinterestedness I have to thank so many valuable additions to my knowledge of bamboo generally.

a.—Bamboos of the Indian Archipelago and Malaya.

Col. Munro, in his monograph above cited, enumerates 30 species of bamboo as occurring in the Indian Archipelago and

the Malayan countries, but not a few of them must be deducted, as they are founded either upon incomplete materials or upon Rumphius' works. These are: *Bambusa tenuis*, Munro; *Bamb. amahussana*, Ldl.; *B. Horsfieldii*, Munro; *B. atra*, Ldl.; *B. fera*, Miq.; *B. maxima*, Poir.; *B. picta*, Ldl.; *B. prava*, Ldl.; *B. teba*, Miq.; *B. vasaria*, Munro; *Bambusa bitung*, Roem and Schult.; *Melocana humilis*, Roep., and *Schizostachyum Blumei*, Munro, not of N. E. Thus there remain only the following legitimate species for the Indian Archipelago and the Malay countries, *viz.*: 1.—*Bambusa Rumphiana*, Kz. (*B. tenuis*, Munro; *B. amahussana*, Ldl.; *B. atra*, Ldl.; *B. picta*, Lindl.; *B. prava*, Ldl.) 2.—*B. cornuta*, Munro (*B. Horsfieldii*, *Munro*). 3.—*B. nana*, Roxb. 4.—*B. Blumeana*, Schult. (*B. Teba*, Miq). 5.—*B. vulgaris*, Wendl. (*B. fera*, Miq). 6.—*Gigantochloa verticillata*, Munro (*B. maxima*, Poir; *B. vasaria*, Munro). 7.—*G. atter*, Kz. 8.—*G. heterostachya*, Munro. 9.—*Schizostachyum chilianthum*, Kz. (*M. gracilis*, Kz). 10.—*Schiz. elegantissimum*, Kz. (*Beesha elegantissima*, Kz). 11.—*Dendrocalamus strictus*, Munro. 12—*Dend. flagellifera*, Munro. 13.—*Dend. giganteus*, Munro. 14.—*Dinochloa Tjangkorreh*, Buse. Besides the above, Col. Munro enumerates *Oxytenanthera nigro-ciliata*, Munro, under which name he confounds 3 or 4 perfectly distinct species; and *Melocanna Zollingeri*, Kz., a species similarly made up of 3 or 4 equally distinct species. Entirely doubtful must remain *Melocanna humilis*, Roep., which nobody will be able to identify unless he studies the Moluccan species on the classical ground. Munro's *Schizostachyum Blumei* is a new species from Hindostan, which I have named *Sch. Hindostanicum*.

The number of species (although some without flowers) known to me to grow in the Malayan area amounts to 24 only, of which however one (*B. nana*) is an introduction from China or Japan. As soon as the Flora of Celebes, the Moluccos, etc., shall become more explored, many species will have to be added. The species are distributed over the following few genera (some of Munro's genera I am obliged to reduce) *viz.*: *Bambusa*, *Gigantochloa*, *Dendrocalamus*, *Schizostachyum* and *Dinochloa*, which all belong to the hexandrous group of bamboo, having only 6 stamens. I let follow here a conspectus of them

with their distinctive characters. As these characters are all based upon the floral parts and fruits, the practical forester rarely can avail himself of these—a thing which is to be regretted, but naturally cannot be helped.

* *Fruit small with a membranous pericarp closely adnate to the seed, and thus resembling oat or wheat; style deciduous; inner palea boat-shaped and 2-keeled.*

Bambusa.—Filaments free. Spikelets usually glossy, pale green to steel-blue, in a dried state straw-coloured.

Gigantochloa.—Filaments united into a tube. Spikelets usually dull-green or purplish-green, opaque.

** *Fruits often rather large, the pericarp separating already before ripening into an outer firmly coriaceous, usually glossy coat, while the inner cellular tissue separates and closely embraces the seed; style persistent, or rarely caducous.*

† Inner palea boat-shaped and 2-keeled. Fruit dry, glossy.

Dendrocalamus.—Style collapsing in fruit, the latter more or less terete.

†† Inner palea concave or convolute, not keeled.

Schizostachyum.—Inner palea convolute, elongate. Fruit somewhat compressed, very long and stiff-beaked. Erect arboreous or shrubby bamboos.

Dinochloa.—Inner palea concave, shorter than the outer one. Fruit terete, ovate, acuminate. Lofty climbers.

I will not undertake to give full technical characters of the genera and species, for such are rarely consulted by the practical forester; but as regards the species I will cursorily mention not only the more prominent botanical characters, but also the distinctive characters used by natives. These latter are specially useful for practical men, inasmuch as they are not based upon floral parts, but upon the shoot-sheaths, general habit and nature of the halms. I shall omit also synonyms, but give a general account of the distribution of the several species.

For the exhibition of botanical characters no method appears to me more satisfactory for the use of practical men than the tabular form usually called an analytical key, which not only gives the differential characters, but also arranges the several species according to the degree of natural affinity. Artificial

keys are handy in certain respects, but slight errors that may creep in may lead the inquirer far astray; besides they appear to me the most mechanical and unnatural method to which a reasoning man can take resource. I must mention here that there remain a good number of species which I was not fortunate enough to study in nature in spite of the trouble I have often taken of obtaining an opportunity of doing so: hence I was naturally compelled, when framing the analytical keys, to take advantage of collateral characters in the absence of the essential ones.

GENUS BAMBUSA, SCHREB.

Conspectus of the species.

SUBG. 1.—*Ischurochloa.*—Outer paleas concave on the back. Lodicules well developed.

* *Rachillae elongate, hence the florets loosely arranged without hiding the rachillae*

† Unarmed. Stigma white.

Shrubby; shoot and leaf-sheaths green, glabrous, sparingly fringed at the mouth, not or only obsoletely auricled ... *B. nana.*

Arboreous; shoot-sheaths coloured, appressed brown-bristly, fringed on the auricled mouth ... ... *B. vulgaris.*

†† Thorny bamboo. Stigma purple.

Arboreous; halms smooth, glossy; shoot-sheaths coloured, dark-brown, bristly all over, strongly setose-fringed at the auricled mouth ... ... *B. Blumeana.*

** *Rachillae short and hidden, hence the florets very crowded and close.*

Arboreous; halms grey—tomentose, much fibrose-rooted at the prominent nodes; shoot-sheaths greyish bristly, rigidly fringed at the auricled mouth; stigmas purple ... *B. aspera.*

Half scandent; leaf-sheaths at one side of the mouth produced into a long slender auricle fringed at the thickened end; stigmas white ... ... *B. corniculata.*

SUBG. 2.—*Leleba*.—Outer paleas keeled, compressed, densely imbricate. Lodicules none.

Shrubby, large leaved ... ... *B. Rumphiana.*

1.—BAMB. NANA, Roxb. (*B. floribunda*, Zoll.)

A small shrubby species 6 to 10 feet high with glabrous halms about as thick as a finger; the shoot-sheaths glabrous and continuous with the leafy erect imperfect blade, minutely fringed on the minute auricles of the mouth; leaves small, glaucous or almost white beneath; spikelets in very poor panicles or almost solitary, above an inch long; the inner palea and the lodicules (these latter often fleshy) nude; stigmas white.

Originally introduced from China and Japan; it is now cultivated all over the Indian Archipelago and the Malayan countries, and forms beautiful dense hedges. It occurs at present also occasionally in a half-wild state on Java and Singapore, and probably elsewhere. It grows there much larger and vigorously at elevations between 2,000 and 3,500 feet.

This bamboo varies greatly in leaf and palm, but as these varieties are all introductions from China or Japan, they will be treated when I come to describe the bamboo of those countries.

Its Malay name is bamboo tjeenah aloos, also bamboo hower tjeena.

2.—BAMB. VULGARIS, Wendl. (*B. Theuarsii*, Kth.)

Arboreous, 30 to 60 feet high and higher, the halms strong, smooth and glossy; shoot-sheaths appressed dark-brown bristly, striped, rigidly fringed at the auricled mouth; leaves rather small, green; spikelets 5 to 8 inches long, in ample panicles; inner palea ciliate on the edges; anthers purple; stigmas white.

A fine species, of which the Malays distinguish the following varieties:

Var. 1.—Bamboo hower hedyoo, or bamboo hower gullies, also bamboo ampel, has uniformly green halms and branchlets.

Var. 2.—Bamboo hower konneng, also bamboo koonieng (yellow bamboo), usually with uniformly yellow halms, or rarely the one or other green and yellow striped.

Var. 3.—Bamboo hower seh-ah, also bamboo kooda, mal.; has the halms beautifully yellow and green striped.

Var. 4.—Bamboo tootool (blotched bamboo), the halms at first green as in the normal form, but turning black-blotched with age.

A very common bamboo in Java, where it grows abundantly in the bamboo-region between 1,500 to 3,500 feet elevation, preferring the sunny shrubby grasslands. But it is seen also everywhere in the plains cultivated as well as wild. At elevations above 3,000 feet it remains low, and the halms become only about an inch thick. Common also on the other islands of the Archipelago from the Moluccos and Celebes westwards to Singapore. This bamboo is at present much cultivated on the Indian Continent, Mauritius, the Cape and even in tropical America.

3.—BAMB. BLUMEANA, Roem and Schult. (*B. spinosa*, Bl. and of the Dutch botanists, but not of Roxburgh).

An arboreous species 30 to 60 feet high and higher, with very strong glossy smooth halms as thick as an arm, the branches abundantly armed with small recurved spines; shoot-sheaths violet brown, yellowish striped, covered with dark brown appressed or almost spreading bristles, with an erect continuous imperfect blade, long and strongly fringed on the decurrent large auricles; leaves small, green; spikelets very laxly flowered, forming large panicles; inner palea minutely ciliate on the edges; lodicules ciliate at the apex; anthers and stigma purple.

This kind is common enough in Java, but becomes more common eastwards, as on Balie and the Eastern Islands as far as the Moluccos; also on Sumatra, Singapore and Borneo. Of this a variety is occasionally found, the spikelets of which become nearly 2 inches long

The Malays call this bamboo dooree or bamboo hower tyook tyook.

4.—BAMB. ASPERA, Poir.

A gigantic bamboo 60 to 90 and up to 120 feet high, the halms greyish tomentose, densely fibrose-rooted on the nodes up to ⅔ of the entire length of them; shoot-sheaths appressed grey bristly, rigidly fringed at the auricles; inner palea white ciliate on the edges and the angles; anthers yellow; stigmas purple; fruit not larger than a mustard-seed, oblong.

This bamboo is in all respects (also in the structure of the spikelets) a *Gigantochloa*, but has the filaments free. It produces the strongest halms, and is, therefore, extensively cultivated all over the Indian Archipelago as far to the north as Malacca. Along the base of the Java hills, at 2,000 to 4,000 feet elevation, it forms extensive forests along with bamb. andong and bamb. atter, in which the rasamala trees (*Altingia excelsa*, the prince of the Java forests) attain their greatest development, just as teak does in the Burmese bamboo-jungles, and how lofty these rasamalas there grow may be best imagined when I say that they push their heads far above the bamboo forests of 100 to 120 feet height.

It is generally known under the Malayan name of bamboo bitoong.

5.—BAMB. CORNICULATA, Munro (*B. Horsfieldii, Munro.*)

An half-scandent bamboo up to 30 feet high, which has the nodes of the branches patellate-dilated; leaves rather small, green; their sheaths produced at the one side of the mouth into a peculiar tail-like auricle 2-3 lin. long and fringed at the broader end; spikelets 3-5 flowered, short; inner palea ciliate on the keels; anthers yellow; lodicules nude and entire; stigmas white.

A very distinct species of the habit of which is very little known besides what the late Zollinger has furnished us with. It occurs in the eastern drier parts of Java chiefly and is there called bamboo nanap.

6.—BAMB. RUMPHIANA, Kurz. (*Leleba Rumphiana*, Kurz, formerly).

A very curious large-leaved shrub 6 to 15 feet high, the halms about 1 to 3 inches thick, very hollow, and only simply (not whorled) branched, glabrous; shoot-sheaths spreadingly bristly, rigidly fringed on the auricles; leaves very large, often spuriously half-stemclasping with their bases and almost sessile; spikelets very compressed, often twistedly elongate; the outer paleas sharply compressed, keeled; the inner ones ciliate on the edges; anthers yellow; stigmas white, but purplish pilose.

Of this species there are numerous varieties, some of them pretty differently looking. Rumphius enumerated these already in his Herbar. Amboin., *viz*:—

Var. 1.—Leleba dyahat or ootan, mal; utte aul boppo, Amb; halms about 1 to 3 inches thick, green, much branched; leaves much larger.

Var. 2.—Leleba pootee, mal.; utto aul tuni, Amb.; as former, but halms becoming whitish in drying.

Var. 3.—Leleba ietam, mal.; utte aul mette, Amb.; halms as thick as a finger, less branched, green or dark-green; leaves smaller, and not half stemclasping at the base.

Var. 4.—Leleba tootool, mal.; tapile, Amb.; as preceding, but halms with dull rose-coloured blotches.

Var. 5—Leleba soorat, mal.; as preceding, but the halms with pale-coloured and dull rose-coloured stripes.

This species will very likely turn out to be really a distinct and good genus when once the fruits shall have become known. It does also not grow inland like other bamboos, but in the marshy coast forests of the Moluccas. It is a free flowerer without dying off in the way of other bamboo. It abundantly flowers in the Botanic Garden of Java and now also in that of Calcutta, without however setting any fruit.

GENUS GIGANTOCHLOA. KURZ.

SUBG. 1.—*Gigantochloa proper.*—Spikelets oval to oval lanceolate; paleas gradually shorter down and upwards; anthers apiculate. Fruit oblong to ovoid. Gigantic bamboos, 60 to 150 feet high; the halms for ⅔ from the ground free of branchings.

Halms almost glabrous, equal at the nodes; shoot-sheaths appressed fulvous-hispid, rigidly ciliate at the auricled mouth, the ligule erose-ciliate ... ... *G. maxima.*

Halms almost glabrous, green, the nodes not prominent; shoot-sheaths appressed blackish hispid, strongly and rigidly fringed at the auricled mouth; the ligule hispid fringed ... *G. robusta.*

Halms greyish green to blackish, glabrous; shoot-sheaths appressed blackish hispid, fringed on the auricled mouth; the ligule minutely ciliate ... ... *G. atter.*

Halms roughish, grey, usually covered with the dried-up shoot-sheaths, the latter appressedly

black-brown bristly naked or nearly so at the mouth, the imperfect blade constantly reflexed *G. apus.*

SUBG. 2.—*Oxytenanthera*, Munro.—Spikelets elongate; the paleas upwards longer; anthers bristly terminated. Fruit elongate-cylindrical. Arboreous, usually branched from far below. Halms glabrous, green; shoot-sheaths appressed brown bristly, fringed at the auricled mouth; outer paleas on the margins, the inner ones on the keels, densely fuscous-ciliate; anthers and stigma purple ... ... *G. nigrociliata.*

1.—GIG. MAXIMA, Kurz. (*Gig. verticillata*, Munr.)

A gigantic bamboo, 60-120 feet high; the halms as thick as a man's thigh, almost glabrous and the nodes not prominent; shoot-sheaths appressed tawny-bristly, rigidly fringed at the auricles; the imperfect blade reflexed; inner palea ciliate on the edges; anthers yellow; stigmas white.

An imposing bamboo like *Bamb. aspera*, and usually growing in society with it or forming forests for itself in the bamboo region of the Javanese hills. Also generally cultivated, and, indeed, never missed in any Malay village all over the Indian Archipelago from the Moluccos to Singapore and Malacca.

Its Malay name is bamboo andong, also bamboo gombong and bamboo dyawa; awie soorat in Sunda.

There are two varieties generally distinguished by the Málays, but the differences are more in size than in other characters. They are the following:—

Var. 1.—Bamboo andong besár. The large andong, has the tallest halms as thick as a man's thigh and thicker; spikelets up to 6-7 inches long, green.

Var. 2.—Bamboo andong ketyeel, *i.e.*, the small andong, shorter and less thick, the spikelets scarcely half as long, more blunt, often purplish.

N. B.—Col. Munro identifies Willdenow's *Bamb. verticillata* with the above, but I doubt the correctness of the identification, the more so as the Javanese name tring atter is given which indicates Gig. atter, a species difficult to distinguish from the above, from Herbarium material only.

2.—Gig. robusta, Kurz.

Arboreous big bamboo 70 to 90 feet high; the halms almost glabrous and the nodes not prominent; shoot-sheaths appressed black-brown bristly, strongly and rigidly fringed at the auricled mouth; the ligule hispid fringed; the imperfect blade spreading; leaf-sheaths white hispid, rigidly fringed at the minute auricles; flowers and fruits unknown as yet.

This bamboo occurs only in the hilly regions of Java, as in Bandong, in Buitenzorg south of Jasinga; also in Bantam. Malay name: bamboo wooloong.

3.—Gig. atter, Kurz. (*Bamb. atter*, Hassk.)

Arboreous, 30 to 70 feet high; the halms glaucous green to black, equal at the nodes; shoot-sheaths appressed black-brown bristly, fringed at the auricled mouth; the ligule minutely ciliate; the imperfect blade erect; inner palea ciliate on the keels; anthers yellow or purple; stigmas white.

Very common in the hilly parts of Java, at 2,000 to 4,000 feet elevation, forming whole forests. Like most other useful bamboo generally cultivated all over the Archipelago from the Moluccos to Sumatra and Singapore. Malay name: bamboo atter or bamboo taman.

There are two varieties of this bamboo, the one with glaucous green halms, the proper bamboo atter; and bamboo ietam, the black bamboo, with halms blackish green to purplish black.

4.—Gig. apus, Kurz. (*Schizostachyum apus*, Stend.; *Bamb. apus*, Roem and Schult.)

Arboreous, 30 to 60 feet high, the halms as thick as an arm, equal at the nodes, roughish, usually covered with the dried-up shoot-sheaths; the latter appressedly black-brown bristly, nude or nearly so at the mouth; the imperfect blade constantly reflexed; leaves large, their sheaths appressed bristly, glabrescent, smooth on the minutely auricled mouth; flowers and fruits unknown.

This is one of the most common species of the Indian Archipelago, easily recognised from long distances by the leaden grey and even whitish to leaden bluish halms covered with the

dried-up shoot-sheaths. Its flowers are still unknown, and I have referred the species to *Gigantochloa* solely by guess. It may turn out to be referable to *Oxytenanthera* with which it agrees better in general habit. It ascends up to 4,000 and 5,000 feet elevation, but grows best in the plains. At elevations above 3,000 feet it remains low and forms thin halms only. While young it is usually called bamboo talie (string-bamboo), because in this state it is chiefly used for strings, ropes, etc.; fullgrown it generally goes under the name of bamboo apoos.

5.—GIG. NIGROCILIATA, Kurz. (*Bamb. nigrociliata*, Buse.)

Arboreous, 60 (according to Zollinger up to 130) feet high, the halms green and almost glabrous; shoot-sheaths appressed darkbrown bristly, fringed at the auricled mouth; the imperfect blade spreading; spikelets 1-1¼ inches long; paleas rigidly dark-brown or blackish ciliate, the inner ones from the middle tawny whitish ciliate on the angles; stigmas purple.

Frequent in Eastern Java, also on Balie and other islands to the east. Its name is bamboo lengka in Malay, but Zollinger gives it also (probably erroneously) the name of bitoong. In habit it greatly resembles *Gig. atter*, from which it is difficult to distinguish without spikelets or shoot-sheaths.

Doubtful Species.

6.—GIG. HETEROSTACHYA, Munro.

Said to have slender halms, 30 feet high; spikelets of two kinds, compressed, resembling those of a *Bromus*, often 12 to 15 inches long, in terminal panicles; lodicules long-fringed; anthers terminating into an hirsute penicillate pilose bristle; ovary long-beaked.

A species which can hardly belong to the genus according to Munro's description, and it may probably turn out to be a *Teinostachyum*. It comes from Malacca, Ayer pannas, about houses.

GENUS DENDROCALAMUS, N. E.

Paleas all sharply spiny-pointed; spikelets straw-coloured, usually pubescent, in dense large clusters; shoot-sheaths truncate at the mouth

and there furnished with a few hairs or nude; low arboreous bamboo ... ... *D. strictus.*

Paleas mucronate only; spikelets dull-green to purplish-green, almost glabrous; shoot-sheaths appressed tawny bristly; the imperfect blade wavedly decurrent and hardly fringed at the base; large arboreous bamboo ... ... *D. giganteus.*

1.—Dendro. strictus, N. E.

A small bushy bamboo, 20 to 30 feet high, the halms green and glabrous; shoot-sheaths more or less appressed tawny bristly, sparingly fringed or nude at the truncate mouth; spikelets in dense large clusters, 5-6 flowered, usually white hairy, forming panicles; outer paleas subulate-spiny, straw-coloured in a dried state; anthers yellow; stigmas purplish.

A xeroclimatic species which is common on the Indian Continent, but does not go further south than Upper Tenasserim. Buse, however, gives Java (Pandahan) as a locality, and Munro identifies a form with very large flower-clusters from Singapore as the above species. The matter requires further inquiry, and I have, in the meantime, made up the above description from Indian specimens.

2.—Dendro. giganteus, Munro.

A large arboreous bamboo, 60 to 100 feet high, the halms pruinose and attaining up to 2 feet and more in girth, the nodes not prominent; shoot-sheaths sparingly appressed fulvous-bristly; the imperfect blade wavy decurrent and hardly fringed; the ligule erose-shaggy, but not fringed; spikelets ovate, green or purplish green, 6 to 9 lines long, clustered and forming large panicles; inner palea long-fringed on the keels and hirsute on the back; anthers yellow; stigmas white.

A large bamboo, apparently restricted to Malacca and the adjacent islands. Col. Munro gives also Tenasserim as a locality for it, but in this he is in error. The habit is so much that of *Gig. maxima* that I would have unhesitatingly brought it in its neighbourhood, had not Col. Munro ascribed a "perigyn" to its fruit.

N. B.—DENDRO. FLAGELLIFER, *Munro*, from Malacca, is unknown to me, and the description not complete enough for identification. It seems to agree so far with *Bamb. aspera*, except in the large leaves.

GENUS SCHIZOSTACHYUM, N. E.

* *Spikelets in nodding heads terminating the leafy branchlets. All florets sessile, except the uppermost sterile one.*

Low halms about as thick as a goose-quill; shoot-sheaths glabrous, hispid at the auricled mouth ... . *Sch. chilianthum.*

20 to 25 feet high; halms very hollow and as thick as an arm; shoot-sheaths appressedly dark brown bristly, sparingly bearded at the hardly auricled mouth ... ... *Sch. elegantissimum.*

** *Spikelets clustered, the clusters in spikes. Only the rudimentary floret, or also the one or other of the hermaphrodite florets, pedicelled.*

† Stigmas white.

○ Imperfect blade of shoot-sheaths erect; ventricose inflated.

Halms glabrous; shoot-sheaths appressedly dark brown bristly; the auricles very large and long-fringed; leaf-sheaths at the mouth fringed with 6 to 10 lin. long hairs ... *Sch. Zollingeri.*

Halms pruinose or powdery, the lateral branchings remarkably short and slender; shoot-sheaths exactly as in the preceding, but the auricles very small and short-fringed; leaf-sheaths at the mouth fringed with 4 to 6 lin. long hairs ... ... *Sch. brachycladum.*

○○ Imperfect blade of shoot-sheaths flat and leafy, reflexed or spreading.

Shoot-sheaths covered with spreading tawny bristles, white-fringed at the produced mouth; leaf-sheaths at the mouth fringed with 3 to 4 lin. long hairs; spikelets ½ in. long *Sch. irratun.*

†† Stigmas purple.

Halms glabrous; shoot-sheaths appressed white bristly, hispid-ciliate on the produced mouth; spikelets ½ in. long ... ... *Sch. Blumei.*

Halms smooth and glossy; shoot-sheaths roughish, sparingly and minutely appressed white bristly, bristly fringed at the auricled mouth; spikelets an inch long... ... *Sch. longispiculatum.*

Flowers unknown, hence the true position doubtful.

Halms smooth; shoot-sheaths appressed black-brown bristly, smooth on the linear-produced mouth; the imperfect blade erect ... *Sch. serpentinum.*

Halms glabrous; shoot-sheaths appressed black—brown bristly, nude at the intensely green, hardly prominent mouth; the imperfect blade spreading or reflexed ... *Sch. Hasskarlianum.*

1.—SCHIZO. CHILIANTHUM.

(*Chloothamnus chilianthus*, Buse; *Melocana gracilis*, Kz.)

A small shrubby bamboo only 6 to 8 feet high, the halms of the thickness of a goose-quill or somewhat thicker, smooth and glossy: shoot-sheaths glabrous, hispid at the auricled mouth; leaves small; flower-heads nodding, long-peduncled; outer paleas glabrous; lodicules ciliate; anthers greenish; stigmas purple.

An elegant small species apparently not unfrequent in the forests of Sumatra and Singapore. The Malay name of it is booloo akkar (Palembang).

2.—SCHIZO. ELEGANTISSIMUM,

(*Bambusa elegantissima*, Hassk.)

A large shrubby species of 20 to 25 feet height and short live (only 3 years); the halms very hollow and weak, half-scandent at the extremities, green, as thick as an arm; shoot-sheaths appressed dark brown bristly, at the mouth hardly auricled and bearded with a few long hairs; paleas rough.

Growing gregariously in the hill-forests between the Tiloo and Malabar mountains in the Preanger regentships, Java, at 4,000 feet elevation; also in Bandong, in the primeval forests of Pekalongan, at 3,000 to 6,000 feet elevation.

It is called awie ul-ul (Sund.), bamboo eh-eh or bamboo oh-oh, pronounced, however, in a way as only a Javanese, with a huge tobacco-ball in his mouth, can do.

3.—Schizo. Zollingeri, Kurz.

Arboreous, 25 to 35 feet high, the halms hollow, up to 2 in. in diameter, glabrous; shoot-sheaths appressedly dark—brown bristly, at the mouth furnished with very large, long-fringed auricles; the imperfect blade ventricose inflated, erect; leaf-sheaths at the mouth long fringed (6 to 11 lin.); spikelets 3 to 4 lin. long, in interruptedly spiked clusters; outer paleas with smooth edges and blunt; lodicules none; anthers greenish; stigmas white.

Frequent along the banks of creeks, etc., especially in the hilly parts of Java; also generally cultivated in villages. The vernacular names for it are bamboo seereet kooda, bamboo goleh-ah and bamboo tyang-kootrook in Malay; also bamboo barekbek. (Sunda). The Javanese distinguish a small variety, bamb. seereet kooda ketyil, and a larger one, b. s. k. besár. The distinction is of an arbitrary nature.

4.—Schizo. brachycladum, Kurz.

Arboreous, 30 to 40 feet high; the halms very hollow, pruinose or whitish powdered, as thick as an arm; shoot-sheaths very like those of the preceding species, but larger and the auricles very small and short-fringed; leaf-sheaths at the mouth rather long (4 to 6 lin.) fringed; spikelets 4 to 6 lin. long, clustered, the clusters forming interrupted spikes; outer paleas ciliate on the edges; lodicules 3, ciliate; anthers purple, turning yellowish with black margins; stigmas white.

This bamboo must be reckoned amongst the rarer ones on Java, but seems to be more frequent on the islands east of Java and on the Moluccos. It is very easily recognised in having all the branchlets unproportionally short and slender, giving it a peculiar habit, by which it is recognisable from a distance of several miles. It is called bamboo booloo by the Malays, and they distinguish two very remarkable varieties of it, *viz.*:—

Var. 1.—Bamboo booloo hedyoo (or idyoo), the green one, which has green halms delicately pruinose all over.

Var. 2.—Bamboo booloo konneng, also bamboo gadeeng, the yellow one, a fine variety with beautifully yellow halms covered with a white powder. The colour of these halms does not fade in drying, as it does in other species, and therefore this kind is much esteemed.

5.—SCHIZO. IRRATUN, Steud.

(*Melocana Blumei*, Kurz, *not of N. E.*)

Arboreous, 20 to 30 feet high; the halms about an inch thick, rarely thicker, hollow, covered with the dried up shoot-sheaths; the latter covered with tawny spreading bristles, white-fringed on the produced mouth and on the shortened ligule; the imperfect blade flat, reflexed or spreading; leaf-sheaths rather long (3 to 4 lin.), fringed at the mouth; spikelets ½ in. long, clustered, the clusters in interrupted spikes; outer paleas minutely ciliate at the apex; lodicules 3, large, nude, or minutely ciliate on the tip; anthers yellowish green; stigmas white.

A bamboo much spread over Java, Sumatra, Balie and the Moluccos, and no doubt occurring also on the other islands of the Indian Archipelago. It delights, like its congeners, in the banks of creeks, etc. Bamboo tamyang is the usual Malay name for it, but it goes under many other names, such as bulu tuy (Balie); tabatico tuy or tuy tuy (Ternate); fuluck (Banda); utte lauit (Ambon); tinat (Hooamohel, Moluccos); bamboo Kasal (Sumatra); awie bong-konol (Sunda).

The Malays distinguish again a larger kind (bamb. tamyang besár), and a smaller one (bamb. tamyang ketyil); besides these, a third variety occurs, which is remarkable for the great percentage of silica contained in the wood of its halms. Owing to this richness in silica the halms emit sparks when cut with the parang (large wood-cutting knives); hence the Malay name bamb. tamyang sonoh.

6.—SCHIZO. BLUMEI, N. E.

(*Melocana tenuispiculata*, Kurz, *in the Bot. Garden, Java.*)

Arboreous, up to 30 feet high; the halms hollow, fragile, glabrous; shoot-sheaths appressedly white-bristly, hispid-ciliate

on the produced mouth and on the shortened ligule; the imperfect blade leafy, erect; leaf-sheaths shortly white-ciliate at the mouth, soon turning naked; spikelets ½ inch long, very thin and stiff, in spiked interrupted clusters; paleas smooth on the edges: lodicules none; anthers green to yellowish green; stigmas purple.

A pretty common bamboo of Java, which, however, I myself met only rarely along torrents and rivulets in the Buitenzorg Residency at 3,000 feet elevation. It is called bamboo irrattun in Malay, but often confounded by inexperienced Javanese with the bamboo tamyang besár.

7.—SCHIZO. LONGISPICULATUM, Kurz.

A large dense shrub, 12 to 20 ft. high, especially characteristic on account of the large leaves and the very long slender shoots which form large depending arches, the halms hardly thicker than a finger, smooth and glossy, often half-scandent at their extremities; shoot-sheaths roughish, glaucous-green, sparingly beset with minute whitish appressed bristles, bristly fringed at the aurieled mouth; the imperfect blade erect or spreading, leafy; spikelets an inch long, in interruptedly spiked clusters; outer paleas smooth on the edges; lodicules none; anthers 2-cleft at the apex, yellowish green: stigmas purple.

Seems to be rather rare in Java, where it grows in Bantam and in the province of Buitenzorg. It is called bamboo mayang, mal.

8.—SCHIZO. SERPENTINUM, Kurz.

A shrubby bamboo, habitually very similar to the preceding and of the same size and foliage, also similarly emitting those curious long shoots from 30 to 36 feet long; the halms 1-1¼ in. thick, strong, smooth; shoot-sheaths appressed black-brown bristly, smooth on the linear-produced mouth; the imperfect blade leafy, erect; leaf-sheaths appressed dark-brown bristly; the ligule much produced; flowers, etc., unknown.

Frequent enough along the base of the Java hills at very low elevations, especially in Buitenzorg and in Bantam. It is called bamboo ooler (serpent-bamboo), and in Buitenzorg it

goes under name of bamboo kriesik. It resembles indeed very much the preceding species, but is entirely distinct in its sheaths.

9.—SCHIZO.? HASSKARLIANUM, Kurz.

(*Beesha Fax*, Hassk., *not of others*).

A dense shrubby bamboo 15 to 20 feet high; the halms hardly 1-1½ in. thick, glabrous, hollow; shoot-sheaths covered with appressed black-brown bristles, nude at the intensely green, hardly prominent mouth; the imperfect blade leafy, spreading or reflexed; leaf-sheaths appressed dark-brown bristly, naked at the auricled mouth, and at the ligule; flowers, etc., unknown.

Occurs along the base of the volcanoes of Java, at elevations between 2,000 and 3,000 feet, also on Sumatra in Padang. It is called bamboo lengka talie, which is a name given also to *Gigant. nigro-ciliata*.

Dr. Hasskarl describes the flowers supposed to be of this species, but I doubt whether they really belong to this plant, as the description of them agrees much more with those of *Schizo. Blumei*. On the other hand, Mr. Teysmann procured me flowers as belonging to this species, which would remove the plant to *Gigantochloa*. It is a species distinct from all others known to me, but its proper position must for the present remain an open question.

GENUS DINOCHLOA, BUSE.

1.—DIN. TJANGKORREH, Buse.

This is a very distinct looking bamboo, at once recognized by being a lofty climber ascending into the highest forest-trees, and depending from them in gigantic festoons. It is very common in the hilly parts of Java and other islands at 3,000 to 4,000 feet elevation, but flowers only rarely. Tjangkorreh is the name by which it is generally known.

The above is a revision of those bamboos of the Malayan countries and islands which have become sufficiently known to serve practical purposes. There remains a small number of doubtful forms which I pass over. The bamboos of the Philippine

islands have also been omitted from the above revision on account of the great obscurity in which most of the species are involved. Australia, too, possesses bamboos on the northern coast, but specimens have never been collected. The only bamboo growing in Polynesia, is *Schizostachyum glaucifolium*, Munro., but this region is too remote from the Indian centre with which a forester in India has chiefly to scope, as to make it necessary to do more than simply allude to the fact.

According to the shape and indument of the shoot-sheaths, and their appendages, the various species may safely be recognised. For this purpose serve the shoots in a somewhat developed state when they are called seeroong by the Malays. Practically it would have been advantageous to give coloured pictures of the sheaths, but their number is too large, and the execution of coloured plates too expensive in India as to allow of their publication. They may be classed in the following way:—

A.—The imperfect blade distinctly separated from the sheath, and therefore more or less deciduous.

* Imperfect blade flat, more or less rounded at the narrowed base.

† *The same erect, or erect spreading.*

Bambusa Rumphiana.—Shoot-sheaths spreadingly bristly, the bristles purple and white; imperfect blade membranous, purplish green.

Bambusa vulgaris.—Shoot-sheaths appressed bristly; the bristles brownish black; the auricles fringed; ligule entire; imperfect blade leathery, green.

Gigantochloa atter.—Shoot-sheaths densely covered with brownish black bristles; the ligule slightly ciliate; imperfect blade leathery, dark or blackish green.

†† *Imperfect blade reflexed, or horizontally spreading.*

○ Shoots, as thick as a thigh or an arm.

Gigantochloa Apus.—As preceding, but the halms roughish and whitish, and the imperfect blade reflexed; the auricles almost obsolete.

Gigantochloa nigro-ciliata.—Also very near to *Gig. atter*, and difficult to distinguish from it, but the flowers entirely different.

Gigantochloa maxima.—Shoot-sheaths covered with reddish brown appressed bristles, smooth on the edges; the ligule fringed; imperfect blade leathery, dark green.

Bambusa aspera.—Shoot-sheaths covered with silvery grey appressed bristles, ciliate on the edges; the ligule long-fringed; imperfect blade dark green, leathery.

Gigantochloa robusta.—Shoot-sheaths almost villous from brownish black appressed and spreading bristles, obsoletely ciliate on the waved edges; the auricles and ligule long and stiff-fringed.

○ ○ Shoots about an inch thick, or somewhat thicker.

Schizostachyum irratun.—Shoot-sheaths covered with white spreading bristles.

Schizostachyum Blumei.—Shoot-sheaths covered with white appressed bristles.

Schizostachyum Hasskarlianum.—Shoot-sheaths covered with appressed brownish black bristles.

* * Imperfect blade ventricose-inflated, leathery, cordate or rounded at the base; sheaths appressed reddish brown bristly.

Schizostachyum brachycladum.—Auricles of the shoot-sheaths small, shortly fringed.

Schizostachyum Zollingeri.—Auricles of shoot-sheaths nearly an inch long, long-fringed.

* * * Imperfect blade linear or subulate.

Schizostachyum longispiculatum.—Shoot-sheaths rough, greyish green.

Schizostachyum chilianthum.—Shoot-sheaths smooth, glossy.

Dinochloa tjangkorreh.—Shoot-sheaths purple, pruinose; climber.

B.—The imperfect blade apparently continuous with the sheath and more or less equally decurrent on it, hence the blade more or less persistent.

Bambusa nana.—Shoots as thick as a finger, the shoot-sheaths glabrous, without or with very small fimbriate auricles.

Bambusa Blumeana.—Shoots as thick as an arm, or thicker, the sheaths densely covered with brownish black bristles, auricles long and stiff fringed.

Malays distinguish also with great dexterity the different kinds of bamboos simply by their halms, but I must confess, I could not succeed in doing the same in any way satisfactorily. If the bamboo is in flower, they say that they also often fail to recognise the species, probably because in that state great changes in colour take place.

In conclusion, I give here a tabular view of the halms of the various bamboo-species, their height, length, and thickness of the joints, diameter of the wood, in French measurement. I have added also the characters by which the Javanese distinguish the several kinds, and these characters I give entirely from oral communication of Javanese versed in bamboo matters.

On plates III. and IV, I have attempted to give graphical representations of these halms, (basal portions only,) and these should be consulted when using the following table :—

Tabular Statement of the various kinds of bamboo-halms and their differences according to the ideas of Javanese.

Plate.	Figure.	Native Name.	Height in meters.	Joints. Length in centimeters.	Joints. Diameter in centimeters.	Thickness of wood in millimeters.	Distinctive characters as given by Javanese.
III.	2	Bamboo andong bezár ...	30—42	40—48	13—15	20	Without prominent nodes, greyish green with greyish-yellowish stripes, covered with a thin appressed felt or almost glaucous.
III.	3	Bamboo andong ketyil ...	20—30	10—16	7½—8	25	Without prominent nodes, yellowish green with yellowish stripes, rough without being felty, when full-grown quite covered with lichens.
III.	1	Bamboo bitoong ...	30—40	32—40	12—13	30—38	The strongly prominent nodes fringed with strong rootlets, quite covered with grey felt, often growing somewhat crooked.
III.	9	Bamboo wooloong ...	30—31	36—48	11—12	26	Like bamboo andong, the halms narrowed and shortened at the base, turning almost glaucous.
III.	4	Bamboo atter bezár ...	20—25	40—45	7—8	20	Without prominent nodes, greyish green, covered with lichens, below the nodes covered with fugaceous, appressed, brownish bristles.
III.	5	Bamboo atter ketyil ...	15—20	32—40	5½—6	19—20	As preceding, the halms somewhat rough, often beset with lichens.
III.	7 & 8	Bamboo apoos or b. talie ...	10—20	32—38	6½—7	15	As preceding, but almost leaden coloured and quite covered with the dried-up sheaths. Figure 8 represents bamboo-talie, which however is nothing but a younger stock.
III.	6	Bamboo ietam ...	14—20	36—40	6½—7	18	Like bamboo atter, but the halms black or blackish purple.
IV	4	Bamboo tootool ...	12—15	30—32	5—5½	16	The nodes hardly prominent, dark-green, not glossy turning black-blotched with age.

IV.	1	Bamboo hower gulies	...	12—20	30—35	$6\frac{1}{2}$—7	15—18	Like the preceding, but always vividly green & glossy.
IV.	2	Bamboo hower konneng	...	10—12	24—25	5—6	23—24	As preceding, but uniformily and beautifully yellow and glossy, often may be seen also striped.
IV.	3	Bamboo hower sehah	...	10—12	25—30	5—6	16—17	As preceding, but all or nearly all the halms elegantly green and yellow stiped, but in other respects not different.
III.	10	Bamboo dooree	...	10—20	30—35	8—10	22—24	Without prominent nodes, yellowish green, glossy; lateral branchlets all prickly.
IV.	5	Bamboo booloo hedyoo	...	10—15	56—60	6—7	$6\frac{1}{2}$—7	Without prominent nodes, vividly green, turning glossy, below the nodes whitish pruinous.
IV.	6	Bamboo booloo konneng	...	10—12	36—45	5—$6\frac{1}{2}$	8—9	Without prominent nodes, beautifully yellow, quite powdery from minute fugaceous hairs.
——	——	Bamboo tamyang besâr	...	10—12	56—60	$2\frac{1}{2}$—3	4	Without prominent nodes, grey-green, sparingly beset with minute fugaceous bristles.
——	——	Bamboo tamyang ketyil	...	7—11	62—65	$2\frac{1}{2}$—3	$3\frac{1}{4}$—$3\frac{1}{3}$	As preceding, only differing in height.
IV.	9	Bamboo tamyang sonoh	...	10—12	65—70	$2\frac{1}{2}$—3	$2\frac{1}{2}$	As preceding, but possesses the longest joints amongst Javanese bamboos; the halms are very firm and to the touch very rough on account of their richness in silica.
——	——	Bamboo irattun	...	10—11	45—52	2—$2\frac{1}{2}$	5	Without prominent nodes, green, beset with whitish minute fugaceous bristles, which become more crowded and more conspicuous just below the nodes. Distinguished chiefly by its seeroongs.
IV.	7	Bamboo goleh-ah	...	8—10	35—40	4—$4\frac{1}{2}$	$4\frac{1}{2}$—5	Without prominent nodes, green, whitish pruinose below the nodes.
——	——	Bamboo kooda	...	10—12	48—40	$2\frac{1}{3}$—$3\frac{1}{4}$	$3\frac{1}{4}$	As preceding, but beset with minute white bristles.
——	——	Bamboo lengka talie	...	5—8	35—36	$2\frac{1}{2}$—4	$7\frac{1}{3}$	Nodes not prominent, grey-green, below the nodes appressed bristly from brownish fugaceous bristles.
——	——	Bamboo ooler or kriessik	...	6—8	30—36	$2\frac{1}{2}$—3	$4\frac{1}{2}$	Nodes very little prominent, green, smooth, grooved at the insertion of the lateral branchings.
——	——	Bamboo mayang	...	4—7	28—33	$2\frac{1}{4}$—$2\frac{3}{4}$	$3\frac{1}{4}$	The nodes bordered with a prominent ring; halms yellowish green, glossy, whitish pruinose below the nodes.

Tabular Statement of the various kinds of bamboo-halms and their differences according to the ideas of Javanese.—(Concld.)

Plate.	Figure.	Native Name.	Height in meters.	Joints. Length in centimeters.	Joints. Diameter in centimeters.	Thickness of wood in millimeters.	Distinctive characters as given by Javanese.
IV.	7 bis.	Bamboo ul-ul ...	10—15	71—50	3—4¼	2—2½	Nodes not prominent, green, smooth, has the thinnest wood-substance.
IV.	8	Bamboo tjina aloos ...	2—3½	32—35	1½—2	4	Halms green or yellowish, glossy; leaves white beneath.
IV.	14	Booloo akkar ...	2—3	22—24	0·5—0·7	2¼	Nodes not prominent, greenish yellow, glossy; small bamboo.
——	——	Leleba dyahat ...	2—3	36—45	1¼—2	3½	Halms yellowish green or yellowish, smooth.
IV.	13	Leleba pooteeh ...	2—3	40—56	1¼—1½	2½	Pale green, smooth, turning white in drying.
IV.	10—11	Leleba soorat ...	3—5	46—52	2½—3	3	Halms green, striped pale yellow or rose, or in both colours.
——	——	Leleba tootool ...	3—5	46—50	2½—3	3	As preceding, but instead of being striped the halms are blotched in the same colours.
IV.	12	Leleba ietam ...	3—5	42—50	2½—3	3¼—3½	Halms blackish green, beset with fugaceous minute bristles, soon turning smooth.
——	——	Tyangkorreh ...	20—27	22—32	1—2	6—7	Climber, the halms somewhat zigzag.

N.B.—An apology is necessary with regard to the measurements being partly French, partly English, and also with regard to the spelling of the vernacular names. My revision of Indian Bamboo was written some 15 years ago, while I was in Java, and with other MSS. and drawings was sent by the Dutch Government to Prof. Miquel, Director of the Imperial Museum at Leyden, where they remained all the time. It was only after the death of this botanist that I succeeded, through the kindness and courtesy of Prof. Suringar, Miquels' successor, to recover my manuscripts, from which a great portion of the material, used in this practical paper, has been taken.

Alphabetical List of the vernacular names of the bamboos of the Malayan Islands.

Ampel jav = Bambusa vulgaris.
Arcuning (hauer konneng) = Bambusa vulgaris, var.
Aule (in Hitoe) = Bambusa Rumphiana.
Aur gadieng = Bambusa vulgaris, var.
Awie, sund = Bamboo generally.
—— bongkonol, sund = Schizostachyum iratten.
—— bunar, sund = Schizostachyum Hasskarlianum.
—— buluh muntie, sund = ?
—— gambong, sund = Schizostachyum Zollingeri ? ?
—— gambong, sund = ?
—— haur tutul, sund = Bambusa vulgaris, var.
—— hiedung, sund = Gigantochloa atter.
—— Leah, sund = Gigantochloa maxima ??
—— mayan, sund = Gigantochloa atter ? ?
—— sarengkol, sund = ?
—— tela, sund = Schizo. Hasskarlianum.
—— terelong, sund = ?

Bamboo, mal. = Bamboo generally.
—— ah ah, sund = Schizo. elegantissimum.
—— ampel, mal. = Bamb. vulgaris.
—— andar, sund = Dendrocalamus strictus.
—— andong besár, mal. = Gig. maxima.
—— andong kekés, mal. = Gig. maxima.
—— andong ketjil, mal. = Gig. maxima.
—— apus, mal = Gig. apus.
—— atter besár, mal. = Gig. atter.
—— atter ietam, mal. = Gig. atter, var.
—— atter ketjil, mal. = Gig. atter.
—— aur goelies, sund = Bamb. vulgaris.
—— aur konneng, sund = Bamb. vulgaris.
—— aur seh-áh, sund = Bamb. vulgaris.
—— aur tjutjuk, sund = Bamb. Blumeana.
—— barekbek, mal. = Schizo. zollingeri.
—— betung, mal. = Gig. aspera.
—— bitung, sund = Gig. aspera.
—— buluh, mal. = Schizo. brachycladum.
—— buluh idjuh, mal. = Schizo. brachycladum.
—— buluh konneng sund. or buluh kunieng, mal. = Schizo. brachycladum, var.
—— djawa, mal. = Gig. maxima.
—— durie, mal. = Bamb. Blumeana.

Bamboo eh-eh, sund = Schizo. elegantissimum.
—— el-el, sund = Schizo. elegantissimum.
—— gadieng, mal. = Schizo. brachycladum.
—— gedeh, sund = Gig. maxima.
—— goleh-áh = Schizo. Zollingeri.
—— gombong, mal. = ?
—— hauer hedjoh (Jasinga) = Bamb. vulgaris.
—— hauer goelies, sund = Bamb. vulgaris.
—— hauer konneng, sund = Bamb. vulgaris.
—— hauer seh-áh, sund = Bamb. vulgaris.
—— hauer tjina (Jasinga) = Bamb. nana.
—— hauer tjutjuk = Bamb. Blumeana.
—— hauer tutul (Jasinga) = Bamb. vulgaris.
—— hitam = Gig. atter, var.
—— ietam, mal. = Gig. atter, var.
—— irrattoen = Schizo. Blumei.
—— kasab (Sumatr.) = Schizo. iratten.
—— konneng = Schizo. brachycladum, also Bamb. vulgaris, var.
—— kuda, mal. = Schizo. Zollingeri.
—— kudu, mal. = Bamb. vulgaris.
—— kriessik, mal. = Schizo. Hasskarlianum and also Schizo. serpentinum.
—— lengka, mal = Dendro. strictus.
—— lengka talie, mal = Schizo. Hasskarlianum.
—— mayang, mal. = Schizo Blumei.
—— minjak, mal. = Bamb vulgaris.
—— nanap, jav. = Bamb corniculata.
—— runieng, mal. = Bambasacea No. 2, Büse.
—— sieriet kuda besár, mal. = Schizo. Zollingeri.
—— sieriet kuda ketvil, mal. = Schizo. Zollingeri.
—— surat (Jasinga) = Gig maxima.
—— talie, mal. = Gig. apus.
—— tamjang besár, mal. = Schizo. iratten.
—— tamjang ketyil, mal. = Schizo. iratten.
—— tamjang sonch = Schizo. iratten.
—— taman, mal. = Gig. atter.
—— tjangkuttuk, mal. = Schizo. Zollingeri.
—— sina, mal. = All small bamboos introduced from China and Japan.
—— tjina alus, mal. = Bamb. nana.
—— tutul, mal. = Bamb vulgaris.

Bamboo ucer, mal. Schizo. serpentinum.
—— wulung = Gig. robusta.
Bitung, mal. = Gig. nigrociliata.
Bule, Makass = Bamb. vulgaris.
Bulu, jav. = bamboo generally.
—— akkar (Palemb.) = Schizo. chilianthum.
—— badurie, mal. Bamb. Blumeana.
—— carissa = Bamb Rumphiana.
—— gadieng, mal. Bamb. vulgaris and also Schizo. brachycladum.
—— gantang, mal. Gig. maxima.
—— jawa, mal. = Gig. atter.
—— kasal (Tum.) Schizo. iratten.
—— key (Banda), Bamb. vulgaris.
—— nitu, amb. = Bamb. Rumphiana.
—— potong, mal. Gig. aspera.
—— samet, mal. = Gig. maxima.
—— serie (Banda) Bamb. vulgaris.
—— seru, mal. = Melocana humilis, *Roep.*
—— swangie (Banda) = Gig. aspera.
—— swangie, mal. Bamb. vulgaris.
—— tombor (Banda) = Bamb. vulgaris.
—— totoan, Makass. = Gig. atter.
—— tuy, mal. (Balie) = Schizo. iratten?
—— wanie, mal. = Gig. aspera.
—— wanie besr, mal. = Gig. maxima.

Domar (Leytimor) Bamb. vulgaris.
Doma (Amb.) = Bamb. vulgaris.
—— habocca (Amb.) = Bamb. vulgaris.
Domul (Amb.) = Bamb. vulgaris.
Domulo (Amb.) = Bamb. vulgaris.

Fuluk (Banda) = ? Schizo. iratten.

Haur or hauer = Bamb. vulgaris.
—— heedjoh = Bamb. vulgaris.
—— goelies = Bamb vulgaris.
—— konneng = Bamb vulgaris.
—— seh-ah = Bamb. vulgaris.
—— tjina = Bamb. nana.
—— tjutjuk = Bamb. Blumeana.

Leleba Amb. = Bamb. Rumphiana.
—— djahat, mal Bamb. Rumphiana.
—— ietam, mal. Bamb. Rumphiana.
—— poopo, mal. Bamb. Rumphiana.
—— putich, mal. Bamb. Rumphiana.
—— tutul, mal. Bamb. Rumphiana.
—— utan, mal. Bamb. Rumphiana.
Leleba (Ternate) = Bamb. Rumphiana.
Louleba (Ternate) Bamb. Rumphiana.
Leuw (Ternate) = Melocana humilis, *Roep.*

Potong, mal. = Gig. aspera.

Samane mal. (Amb.) = All Larboreous bamboo.
Sammat mal. (Amb.) = All Larboreous bamboo.
Suelen (Banda.) = Melocana humilis, *Roep.*

Tabat (Hœamohel) Bamb. Rumphiana.
Tabatico (Ternate) Diverse kinds of bamboo.
—— ake, (Ternate) = Gig. aspera.
—— java (Ternate) = Gig. atter.
—— nanie, (Ternate) = Bamb. vulgaris.
—— sammat (Ternate) = Gig. maxima.
—— tuy (Ternate) = ? Schizo. iratten
Tallam, Makass = Melocana humilis, *Roep.*
Tamalla (Balie) = Melocana humilis, *Roep.*
Tapiie (Hœamohel) = Bamb. Rumphiana.
Teba-teba (Amb. Ternate) = Bamb. Blumeana.
Telin, amb. = Gig. atter.
—— hahulu, amb. Gig. aspera.
Terin, amb. = Gig. atter.
—— hahuru, amb. Gig. aspera.
—— maysele, amb. Gig. maxima.
Tjangkorreh, sund. Dinochloa Tjangkorreh.
—— di-uk, sund. Leptaspis urceolata.
Tihing ampel (Balie) = Bamb. vulgaris.
Tilapong (Balie) Gig. atter.
Tinat (Hœamohel) ? Schizo. iratten.
Tuy-tuy (Ternate) ? Schizo. iratten.

Utte, amb. = bamboo general.
—— aul or aule (Hitola) = Bamb. Rumphiana.
—— aul boppo, amb. = Bamb. Rumphiana.
—— aul mette amb. = Bamb. Rumphiana.
—— aultuni, amb. Bamb. Rumphiana.
—— aux (Leytimor) = Bamb. Rumphiana.
—— lauit, amb = Bamb. Rumphiana.
—— onitu, amb. = Bamb. Rumphiana.
—— wanie, amb. = Gig. aspera.
—— wannat (Hœamohel) = Melocana humilis, *Roep.*

Waan semane (Hœamohel) — Bamb. vulgaris.
Wanake (Lahœa) Bamb. Blumeana.
Wannat, amb. = Melocana humilis, *Roep.*
Wulu, = Bamboo generally.

EXPLANATION OF THE PLATES.

PLATE I.—Fig. 1, shoots (rebongs) of bamboo andong, much reduced in size; fig. 2, a portion of a bamboo-halm screw-like twisted; fig. 3, a portion of a bamboo-halm with inflated joints (natural size); fig. 4, normal spikelet of leleba (*Bamb. Rumphiana*), enlarged; fig. 5, a proliferous one of the preceding, nat. size; fig. 6, spikelet of bamboo dooree, much elongated variety, nat. size; fig. 7, cluster of spikelets of *Schizo. longispiculatum*, nat. size; fig. 8, a pair of spikelets of preceding, shewing the sterile pedicelli, nat. size; fig. 9, a cluster of spikelets of bamboo andong besár, shewing some of the spikelets grown out into floriferous branchlets terminated by the sexual flowers of the original spikelet, nat. size; fig. 10, a similar cluster of spikelets of bamboo atter; ♂ male flower, ☿ hermaphrodite ones, nat. size.

PLATE II.—Figs. 1 to 12, exhibiting the germination of *Schizo. chilianthum*; fig. 1, caryopse as it falls from the plant, retaining the paleas and the sterile terminal floret; fig. 2, id., the paleas removed, shewing the persistent lodicules; fig. 3, id., longitudinal section; fig. 4, the seed seen from the side; fig. 5, id., seen from the front; fig. 6, germination on the 4th day; fig. 7, further development on the 5th day; fig. 8, id., on the 6th day, *b*, section of it on a smaller scale; fig. 9, id., on the 9th day, *a*, from the side, *b*, from the front; figs. 10 to 12, stages of the 11th, 15th and 35th day respectively. All figures except 11 and 12 more or less magnified. Fig. 13, a flowering and fruiting portion of a panicle of *Pseudostachyum compactiflorum*, nat. size; fig. 14, fruit of bamboo dooree (*Bamb. Blumeana*), *a*, nat. size; *b*, magnified; fig. 15, fruit of bamboo bitoong (*Bam. aspera*), *a*, nat. size; *b*, magnified; fig. 16, fruit of bamboo lengka (*Gigantochloa nigrociliata*) *a-b*, both nat. size; fig. 17, fruits of the male bamboo (*Dendrocalamus strictus*), *a-b*, both nat. size, *c*, magnified.

PLATE III.—*Diverse bamboo-halms.*—Fig. 1, bamboo bitoong (*Bamb. aspera*); fig. 2, bamboo andong besár (*Gigantochloa maxima*); fig. 3, bamboo andong ketyil (*Gig. maxima, var.*); fig. 4, bamboo atter besár (*Gigantochloa atter*); fig. 5, bamboo atter ketyil (*Gig. atter var.*); fig. 6, bamboo ietam (*Gig. atter, var.*); fig. 7, bamboo apoos (*Gigantochloa apus*); fig. 8, bamboo talie (*Gig. apus*); fig. 9, bamboo wooloong (*Gigantochloa robusta*);

fig. 10, bamboo hower tyootyook or dooree (*Bamb. Blumeana*).

PLATE IV.—*Diverse bamboo-halms*, continued.—Fig. 1, bamboo hower gulies (*Bambusa vulgaris, var. viridis*); fig. 2, bamboo hower konneng (*Bamb. vulgaris, var. lutea*); fig. 3, bamboo hower seh-ah (*Bamb. vulgaris, var. striata*); fig. 4, bamboo tootool (*Bamb. vulgaris, var.*); fig. 5, bamboo booloo hedyooh (*Schizostachyum brachycladum, var. viride*); fig. 6, bamboo booloo konneng (*Schizo. brachycladum, var. luteum*); fig. 7, bamboo golebah (*Schizostachyum Zollingeri*); fig. 7*bis*. bamboo ul-ul (*Schizostachyum elegantissimum*); fig. 8, bamboo tjina aloos (*Bambusa nana*); fig. 9, bamboo tamyang sonoh (*Schizostachyum irraten, var.*); figs. 10-11, leleba soorat (*Bambusa Rumphiana, var. striata*); fig. 12, leleba ietam (*Bamb. Rumphiana, var. nigra*); fig. 13, leleba pooteeh (*Bamb. Rumphiana, var. alba*); fig. 14, booloo akkar (*Schizostachyum chilianthum*).

Notes on the Burmese varnish and some other articles of minor Forest produce in Pegu.

By D. BRANDIS.

I am not aware that the extraction of the black Burmese varnish has ever been fully described, and it may perhaps interest the readers of this Magazine to learn something more on the subject. The varnish tree, Melanorrhœa usitata, belongs to the order of Anacardiaceæ, which comprises the Mango, the Piár or Chirongi, (Buchanania latifolia) the Bhiláwa (Semecarpus Anacardium) and the varnish tree of Japan (Rhus vernicifera). It is found almost everywhere in the Eng Forest of Pegu and Tenasserim; and in the Tharawaddi district, it is particularly common in the lower part of the Eng belt, where the soil is better than further east near the foot of the Yomah. The tree does not attain the same size as the Eng, Engyin or Theya, and at this time of the year (December) it may be known at once by its darker foliage. The leaves resemble those of the Burmese *Semecarpus* (Chayben) they are ovate-lanceolate, pointed at both ends, and covered with soft short pubescence; they are narrowed into a short petiole, while the leaves of Eng (Dipterocarpus tuberculatus) are glabrous, much larger,

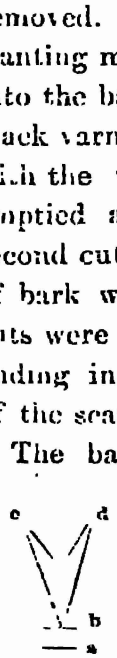
and have a broad cordate base. Those of Engyin (Pentacme Siamensis, Kurz) which have about the same size, and of Theya (Shorea obtusa) are also glabrous, of an oblong shape with rounded ends. While these trees are in leaf it is easy to distinguish them. A large proportion of the Thitsee trees in the vicinity of Tyemyouk are lopped, but we saw large numbers along the road which had not been touched, and this important industry might be increased to a large extent.

The process was described to me by a Shan who had settled at Tyemyouk 4 years ago, and had like many thousands of his countrymen emigrated from Upper Burma into British territory with his entire family. Near Myoung, 6 miles further north, Thitsee is collected by Burmans, also emigrants from Ava. Moungmyat, this is the name of the gentleman who taught us his art, is a native of Thoonzay, 5 marches east of Mandalay, on the Myitgne, a tributary stream of the Irrawaddy, which joins that river near the site of Ava, the former Capital of Burma. The province (Myo) of Thoonzay is situated in about 23° North Latitude. The country is mountainous, the higher hills being clothed with Pine Forest (probably Pinus Kasya) the wood of this pine, he said, was not used for building, as it was not durable, but torches were made of it. Teak is found on the lower hills and the forests are worked. There is also Eng Forest with Thitsee, from which much varnish is extracted, and a large number of other trees found in Pegu, such as Taukyan (Terminalia), Bambonay (Careya), but there is no Pynkadoe (Xylia dolabriformis,) Pymmah (Lagerstroemia Reginae) Myauk-shaw (Blackwellia tomentosa), no Thingan (Hopea) or Kanyin (Dipterocarpus). Those who are acquainted with the Forests in India, will see at once that some of these trees are found in South India, though they are wanting in North and Central India. Of cultivated trees the Mango, Plantain, Custard-Apple, Jack fruit are common in that part of the Shan States, while the Cocoanut, the Borassus and Thittoben (Sandoricum), all purely tropical trees, are wanting.

But now to the extraction of varnish. The trees which have been tapped are at once known by triangular scars about 9 inches long and 5 inches broad, the apex pointing downwards.

On some trees we counted 40-50 of these scars, and some of them at a height of 30 feet. To work the higher scars the Shans use a most ingenious ladder which is permanently attached to the tree. It consists of a long upright bamboo with holes cut through at intervals of 2-3 ft. Through each hole are passed two flat bamboo sticks driven with their pointed ends into the bark. These form the spokes of the ladder and are about 12 inches long. The scars or notches to extract the varnish are made with a peculiarly shaped chisel about 15 inches long, the handle is of iron, of one piece with the chisel and about 9 inches long, the lower end thicker, hollow and closed with a bamboo plug. The chisel is wedge-shaped, about 6 inches long (the edge half an inch broad) and forms an obtuse angle with the handle. With this instrument two slanting slits, meeting at an acute angle are made upwards through the bark, and the triangular piece of bark between the two slits is thus slightly lifted up, but not removed. A short bamboo tube about 6 inches long, with a slanting mouth and a sharpened edge is then horizontally driven into the bark below the point where the two slits meet, and the black varnish which exudes from the inner bark near its contact with the wood runs down into the bamboo tube, which is emptied at the end of ten days, when it ceases to flow. A second cut is then made so as to shorten the triangular piece of bark which had been separated from the wood when the first cuts were made. A shorter triangular piece of bark remains, ending in an angle less acute than before, and the appearance of the scar is then as below.

The bamboo tube, which before was at *a*, is moved a little higher, (to *b*) and the edges of the original cut, (*c b* and *d b*) are cut afresh. The varnish then runs out for another 10 days after which the scar is abandoned. The trees vary in yield exceedingly, a crooked tree with scanty foliage which we examined, was said to yield a good outturn, while some of the largest trees were said to yield very little. We saw trees tapped which had a diameter of only 9 inches. Moungmyat informed us that one man could make and look after 1,200 scars, that he could do 200 in a day, so that the whole number occupied 6 days, which



left 4 days for rest. They only work in those parts of the forest, where the tree is abundant and the trees fit to tap stand close together. The tree yields nothing while it is leafless in the hot season, and the best season for working is from July to October. One man collects 40-50 viss, (146 to 182 lbs.) in one season, at Tyemyonk the viss sells for 12 annas and at Rangoon for one Rupee.

In the slack season these men are employed in making torches of the Eng tree woodoil, and I add a few particulars regarding the collection of this valuable article. Unlike the varnish the woodoil exudes not from the bark, but from the outer layers of wood, to a depth of about 2 inches. Neither the outer grey bark, nor the inner red bark, yield woodoil. The Eng tree belongs to a natural order of plants different from that of the varnish tree and the Kanyin tree which is of the same order, also exudes woodoil from the outer layers of wood. It will however be remembered that among conifers, which all belong to one natural order, some, such as the Larch and Pinus Pinaster, exude resin from the wood, while others, like the spruce, produce it in the bark. Deep semi-circular niches are cut into the wood, the first cut is about 4-6 inches deep and 12-18 inches wide, the bottom of the niche being slightly hollowed out, to receive the oil. It oozes out and collects at the bottom of the niche about 3 days after the cut has been made. The surface is then charred with fire, after which the oil runs for three days; this process is repeated four times, and at the end of 15 days the surface of the niche is cut afresh, the old charred wood being cut away and the niche enlarged. After the oil has run for three days, the surface is again charred, and the original process repeated. The Eng tree yields oil throughout the year, and one tree often yields oil from several niches at the same time. I saw a tree with 6 niches, two of which were yielding oil at the time. One man can make 2,000 to 3,000 torches in a year, and 100 torches require about 10 viss (36 lbs) of oil which is mixed with touch wood and neatly wrapped up in the leaves of palms or of the Tsathoaben, a species of Pandanus, so as to form cylinders about 20 inches long and 2 inches in diameter. They

are tied with thin strips of bamboo, generally Tinwa, (Shizostachyum pergracile). Elsewhere, *e. g.* in the Hlaine district, the leaves of the Zalooben (Licuala peltata) are used for this purpose. This is the information which was given me in the Eng Forest of Tyemyouk, and if it is correct, a man can collect about 700 to 1,000 lbs of woodoil in a year. These torches are sold at Rs. 3-8 or 4 a hundred near the Forests. The woodoil of the Kanyin tree is collected precisely in the same manner. One man can manage 30 to 40 oil yielding Kanyin trees; he goes round with a number of hollow bamboos or other vessels and one collecting gives him 3 to 4 viss. In Pegu the torches made of the Kanyin oil sell at the rate of 64 per rupee.

The collection of minor Forest produce in Burma, such as the Woodoil of the Eng and Kanyin trees, the leaves of the different trees which are used as covering leaves for the Burma cheroot, Bambouay, (Careya arborea) Thanat, (Cordia grandis)—and the most valuable of all the Mhayah ben, (also a species of *Cordia*) the manufacture of catechu, the collection of varnish, of the stems of Maranta dichotoma, of which the beautiful soft Thinbyu mats are made, of rattans, of the bark of several trees, especially of 3 species of Sterculia, for rope, and of an immense variety of other useful and necessary articles is as yet perfectly free in the Government Forests of Burma. Of many of these articles the supply is almost unlimited, but of some the supply has already become scarce, and early measures will have to be taken by the Forest Department to increase the supply and to prevent waste as far as practicable. Thus the leaves of the Mhaya tree are now imported into Rangoon from the Gamoong and other Forests of North Tharawaddi; they are dried by an old, but most ingenious process, a round shallow iron pan 18 inches diameter is heated over a fire, the leaves are placed on it 4 or 5 one on the other, and are ironed with a flat disk of basket work (kyattonk) covered with cotton cloth, and filled with stones, a wooden handle being in the middle. The leaves which are 12 to 15 inches long are sold by number, 10,000 leaves selling for 6 to 10 rupees at Wyne near the Forests; and for 15 to 20 rupees at Rangoon. They are most carefully packed in large baskets which are

either carried on men's shoulders or carted to the Meimakha river whence they go down in boats. I found the tree cultivated at Kwemma village near the Beeling river. Formerly Mhaya leaves were largely exported from the Hlaine Forests to Rangoon, but the destruction of the tree has been so great, that the supply from that district is exhausted. The export from Tharawaddi will probably have a similar end, for the trees are cut and lopped most recklessly to obtain the leaves; and many trees have died from this treatment. Another article which is becoming scarce is Catechu, and as the demand for this beautiful and most useful substance is apparently increasing rapidly in Europe and America, and as the price is rising, steps have already been taken to increase the supply, and it may be necessary to restrict the indiscriminate cutting of Catechu trees in British Burma. An article of universal use for rope manufacture is the bark of three species of Sterculia, Showbju (S. foetida) shownee (S. villosa) and showwah (*S. ornata*). The useful portion is the inner bark or liber, it is peeled off in the hot season, and trees of all ages and sizes are recklessly felled to obtain it. The bark of all 3 species is of the same value, but that of the Showbju is most difficult to peel off. At present 100 viss. of show sell for 10 rupees at Tsayjoua in the Minhla district, 20 years ago the price was about one-half of this. The varnish is another important produce, the demand for which is certain to increase, and a permanent supply of which must be secured. No difficulty need arise in this respect, if things are properly managed, for all that is required is, to include within the limits of the Reserves a sufficient area of Forest producing Catechu, Thitsee, Show, the Mhaya tree and other trees which furnish useful produce.

Camp Koon Beeling, December 1875.

Report on the collecting of seeds and plants of the India-rubber tree (Castilloa elastica) in the forests of the Isthmus of Darien.

By Robert Cross.*

The following is a detailed statement of my late journey to the Isthmus of Darien, where I have been recently engaged in making a collection of seeds and plants of *Castilloa elastica*, the tree which chiefly yields the India-rubber of commerce exported from the Republics of Central America, Mexico, New Granada, and Ecuador. In conformity with instructions received from Mr. Markham during the early part of this year, I left Southampton on the 2nd of May and reached Panama on the 26th of the same month.

I remained at Panama for fifteen days in order to gain all information regarding the size and yield of the rubber trees of the various districts. The tree is found growing from 1° south latitude to 20° degrees or more north of the Equator, but in such a wide expanse of country there are probably various varieties, most of which however may bear a close resemblance to each other, although some may be of more robust habit than the rest, and attain to a greater size. Experience has proved that such is the case with most families of wild plants when brought under cultivation. Of late years a good deal of India-rubber has been brought from the forests on the Pacific Coast, South of Panama, near to a scattered village called Darien. The Indians in this region have been rather hostile to the collectors, and the export has in consequence been much reduced. The greater portion of the interior of the Isthmus has been explored and the largest trees have been cut down. North of Panama, in the district of Chorera, there were once considerable numbers of trees, but these have been, to a great extent, demolished by the natives, who usually cut down the trees in order to tap or bleed them more easily. The replies to my inquiries respecting the size to which the India-rubber trees grow in the forests about the village of Darien

* This interesting report has been sent to us by Mr. Clement Markham, to whom we herewith tender our best thanks.—The Editor.

did not fully satisfy me. Therefore I proposed to examine the woods on the confines of the larger tributaries of the river Chagres, where trees of large dimensions were formerly met with. The period of my arrival at Panama happened to be the wet season of the year, which in the region of swamp and forest is considered particularly unhealthy. Indeed on this account Captain Mallet, H. M.'s Consul at Panama, thought I should await the return of the dry season. I afterwards found that his remarks concerning the climate were quite correct, and except for the experiences I had previously obtained while travelling in the hot valleys in the interior of New Granada, I would in all likelihood have been prostrated with fever. But the seeds ripened during the rainy season, so that it was important to examine the forests for seed-bearing trees at this period.

Journey to the forests.—On the 9th of June I left Panama by the railway and stopped at a place called Gatun, about 8 miles from Colon. Leaving the railway tract, I crossed the Chagres and took up my quarters in the village of Gatun which is built on the northern bank of the river. The town is formed of two streets 150 yards long with rows of houses on each side thatched with palm leaves. In most instances the walls of these houses are patched up in a miserable manner. Alligators swarm in the river, and any one who might attempt to bathe in it would soon be devoured. Water is obtained for domestic purposes from barrels sunk in the ground in low situations; they are provided with lids and must be kept constantly covered to prevent toads and snakes from entering. The village contains about 300 inhabitants, the greater number of whom are of Negro extraction. The situation is so low that during high floods the streets are inundated, and people ply about from house to house in canoes. On both sides of the river the country is swampy, although in great part clothed with forest. Penetrating into these woods I found the place swarmed with mosquitoes, frogs, and uncountable millions of ants, and the snakes, instead of getting out of the way, raised their heads in a position of defence, ready to strike at any one who approached. These swamp forests present a dis-

mal aspect and reminded me of the mangrove forests (*manglares*) which grow in the flat deposits of fetid mud that occur on the margin of the Gulf of Guayaquil, and other places along the Pacific Coast. The native with whom I was located at Gatun was a good fellow, but the greater number of the inhabitants were disobliging and uncivil. They were positively the worst class of people I have yet met with in any country. Everywhere the land, if cultivated, produces abundantly, but such is the indolence of these people that bananas, rice and mandiocas are raised in limited quantity scarcely indeed sufficient to maintain them. I found on inquiry that no India rubber trees existed in the swamp forests, and that to find them it would be necessary for me to ascend the river for some distance and then travel up to the dry land of the interior. The person with whom I lived collected India-rubber, and he had a hut in the heart of the forest, where the collectors often staid for the night. A few days after my arrival he proposed going to this place, and although the weather was unfavourable I resolved to accompany him, as I was anxious to become well acquainted with the *habitat* of the tree, and also to ascertain if any seeds were to be found. Leaving at early morn, in a canoe, we ascended the river Chagres for a number of miles and then entered a smaller river called *Vino tinto*, which rises from a large swamp in the interior. The water of this river was full of decayed vegetable matter, appearing as if vast quantities of the trunks and leaves of trees had been systematically ground up and mixed with it. On the banks, which were high, grew an astonishing rank growth of large trees and bamboos, and many of these had fallen into the water and lay partially submerged, thus forming serious obstacles for even the navigation of a canoe. Beyond the landing point a short distance of swamp land was travelled over, on which grew principally thickets of palm trees and bamboos. Then the way ascending led to drier land with some flat undulations, the greater portion of which had an elevation of about 50 feet above sea level. An India-rubber tree was first seen in this locality growing near to a little stream in a very moist situation. Saplings or young rubber plants were subsequently met during the rest of my

journey. After passing the flat land we ascended a ridge of low hills and undulating inequalities, which were clothed with the stateliest forest I have ever witnessed. Many of the trees, belonging to the order *Lauracea*, had straight smooth stems which rose often to a height of 150 feet without a branch, and a massive species of *Bombax*, called by the Indians *quipe*, grew mostly on the summits of the hills, and had frequently a clear trunk of 200 feet high with a flat crown of green foliage like an umbrella, giving to these hills a grandly imposing and majestic appearance. Palms of various species were tolerably abundant, and in places the undergrowth was composed of extensive thickets of a species of *Bromelia*, which had formidable prickly leaves ten feet in height. Both the trunks and branches of the trees were destitute of mosses (*Selaginellas*), although a robust species interwoven with *Adiantums* formed luxuriant clusters on the ground. A species of cacao (*Theobroma cacao*) grew wild on the hill sides and in the ravines. Its short slender trunks and branches were adorned with many fruits each of which enclose a number of cacao beans. However these, on ripening, are duly visited by monkeys, hundreds of which were jumping about and screaming among the tops of the trees. The rubber saplings always appeared to grow most freely on the banks of little cool clear streams, the roots often running down to the edge of the water. They abounded also in deep rich soil along the base of the hills, and in both deep and shallow ravines. Plants were likewise met with on the summits of the ridges and in fact in all localities where there was no swamp or marsh land. Some plants were observed growing among masses of volcanic rock, where there was not much soil, but plenty of decaying leaves and particles of *debris*. Prostrate trunks were observed on the way, some of which had attained to a great size. We reached the rubber hut rather late, having travelled two days journey in one. The hut was situated on an eminence between two ridges of hills. A stream of water flowed past the dwelling. It swarmed with incredible numbers of little fishes about the size of needles. A small portion of forest had been cut down and a little Indian corn and a few roots had been planted. The

trunks of some of the felled forest trees were five feet in diameter. Formerly a great many large rubber trees were found at this spot which had yielded to the collectors a rich harvest. Probably for this reason they called the place La Providencia. In the surrounding forest grew some young rubber trees, a few of which averaged from 50 to 70 feet in height. One of these bore a considerable number of unripe fruit. It was evident the fruit would take from ten to fifteen days to ripen.

Meanwhile I resolved to search for some young plants to experiment with. An Indian who was employed to take care of the hut and its stores lent me one of his sons, a lad about fifteen years of age. He came away with me completely naked and entering the forest we succeeded in collecting 40 good plants. Returning to Gatun I rested a few days, and made two more journeys without finding any quantity of seeds. But the fruit of the tree already alluded to was approaching maturity and it was necessary that these should be watched. Revisiting the place on the 18th of July I found the seeds had ripened. To facilitate the work of collection the tree was cut down and all the mature fruit was gathered. The fruit has a short stalk and springs from the axils of the leaves. It resembles in some measure a *Jargonelle* pear, but is shorter, and is diversified with rough scales. The crown is flat, and when ripe, assumes a beautiful scarlet colour, while all the rest of the fruit remains green. The seeds in size and appearance resemble coffee beans, and are immersed in an orange-coloured pulp. The soft pulpy matter was washed away and the seeds were put to dry. I was disappointed on observing that some of the seeds had already begun to germinate. This indeed was to be expected; for they have no hard covering and when ripe are nearly as easy to bruise as green peas. In fact it seems natural for these seeds enveloped in a soft juicy mass to begin to grow whenever the fruit falls to the ground or even sooner. I now resolved to go on to Gatun without delay, and dispatch the seeds as early as possible from Panama. In conformity with a previous arrangement a negro came on July 21st to the landing place of the Vino tinto River to take me down to Gatun. The canoe which I had brought up with me had been taken by a

native without permission; but he had left another in its place, which, although smaller, was still large enough to carry two persons if managed with prudence. The negro had got together various things which he was not expected to take and which with ourselves formed a full load for the canoe, even if managed with care. It had already rained lightly for several hours, but at the moment of embarking the rain came down in torrents, and if not baled out would soon have filled the canoe. I was in the prow of the canoe and the negro in the stern, steering and paddling as the case might require. The river was much swollen with driftwood and trunks of trees in every direction, and I several times warned the negro of these obstacles, but unlike the Indians, he had no patience for surmounting difficulties, or it may be the tempest put him in a reckless mood. From the first I expected we would have an accident and put off my boots and part of my clothing so as to be able to swim if anything happened. We had only gone a short distance when I observed a stout projecting trunk near the surface of the water a little in advance and directly in front of the canoe. I immediately told the negro of it, but received only a low grumbling sound in reply. In a few seconds after the canoe struck against the trunk.

The shock caused the prow to sweep round towards the river bank, but at the same moment a quantity of water rushed in at the stern. I saw it was now time to endeavour to make an escape and jumping into the water I pushed myself off from the canoe and with only two strokes of swimming was able to take hold of the bushes on the river bank. On looking round I saw the negro struggling in the water having a hold of the canoe and attempting to find a footing on some of the sunken trees. At length he managed to get to the river's edge very much exhausted. But the accident was entirely his own fault; for with a due amount of caution it would not have occurred. The canoe was baled out and we resumed our journey.

As I had now no great confidence in the abilities of the negro as a navigator, I took off all my clothes and sat in the canoe naked until I reached Gatun. In this state I could swim more easily if such another accident took place. During the

journey down the river it rained the whole time and I shivered from the cold, although the temperature must have been at least 75° Fahrenheit. On arriving at the village I put on dry clothing, drank a cup of hot coffee, and felt well afterwards.

The negro who slept for the night in a corner of the same apartment as I did, awoke me several times by sighing, talking to himself and moving about restlessly, so that mentally as well as physically he seemed to have suffered most.

During the succeeding days I had great difficulty in drying the seeds, as it rained almost continually, so that the atmosphere was saturated with moisture. The rain was often accompanied with cold winds which brought on much sickness among the inhabitants. The illnesses with which most were afflicted were fevers, dysentery and ulcers. Of these diseases about 80 per cent. of the population were suffering. The former, which is usually known by the name of "Chagres fever," is the worst and most debilitating in these parts. It is stated by some that dysentery is brought on by this kind of fever. The plague of ulcers, which was very common, was a new phase of disease to me, for although I had travelled in the hot pestiferous valleys of the interior of New Granada where the inhabitants are systematically devoured by *lepra* and cancerous diseases, I saw nowhere the same type of ulcers as here on the Isthmus. A native told me these were produced by the bite of a mosquito. It is apparent that the disease is confined to the swamp forest districts. A stout robust healthy boy on one occasion ferried me across the Chagres River. About three days afterwards I wanted him, but found that an ulcer had broken out on his ankle and was now three inches in diameter. The rapidity with which these ulcers increased was truly surprising. During my various journeys to and fro in the forest, I sometimes travelled barefoot and had a number of scratches and tears, but these shewed no disposition to become ulcers. On the contrary, they seemed to heal more quickly than in a cold climate. However I do not know how long this good fortune might have continued. At times I had occasional touches of cold ague, but without headache. Yet the food was dear and scarce, and the

habitations everywhere were of the most wretched description. Sometimes a snake escaped from the swamp behind the village and was seen to enter the patched up wall of some dwelling. Such an event caused a great stir among the inhabitants, a number of whom would surround the house in order to capture the reptile. These efforts were in general unsuccessful.

Dispatch of Seeds from Panama.—On the 27th of July I went on to Panama for the purpose of forwarding the seeds. From what I had already observed I had little confidence that they would succeed, as all oily seeds are well known to lose their germinating power very early. But it was best that there should be a trial, although I had all along fully resolved to take with me a collection of plants. On the 5th the seeds, amounting to upwards of 7,000, were kindly forwarded by Captain Mallet, H. M.'s Consul at Panama, a gentleman from whom I invariably received all necessary advice and assistance. With the change of residence to Panama it seemed to me as if I had really entered a kind of paradise. The difference was great from my previous location, where I had been living on a very limited supply of food in a low-roofed damp hut, from the eaves of which the dropping of water hardly ever ceased, and where the whole scene was walled round by green mantling thickets of lofty forest trees, bathed daily by drenching rains.

Return to the forests for India-rubber plants.—As I have already remarked I fully purposed to bring home some plants with me, and I now made arrangements for accomplishing this object. On my return to Gatun the rains came on with increased violence, and the river was greatly swollen. Yet even with the unfavourable weather a collection of plants was got together from various localities around La Providencia. I was assisted by three natives one of whom was bitten on the leg by a bat when he was asleep. From this simple accident the man was laid up for four days. Although found growing in varied aspects the plants were not met with very plentifully. But in one locality upwards of 100 plants were found growing under a good-sized tree. The seeds had fallen on a bed of decaying leaves and germinated in

great numbers so thickly indeed that many of the plants had smothered each other. In all six hundred plants were collected, but a good number were bruised, while being carried through the forest, or during the journey to Gatun. A quantity of the milk of the tree was also secured. Mr. Matthew Gray, a member of one of the largest rubber-manufacturing firms in London, kindly made some remarks to me concerning the preparation of the article. I therefore endeavoured to prepare a specimen with some care. But I did not succeed with the operation as I intended, for I had very little room and the natives crowded about me too much, as they were curious to see how I did everything. The milk-like juice of the tree had thickened a good deal during the journey, so I spread it out on a piece of zinc exposed to the sun and put a boy to stir it about a little, when it soon became firm. It was then taken off the zinc and hung up to dry. Notwithstanding the rough method of preparation the sample seemed of fair quality. I next turned my attention to the plants and dressed them very carefully. These were young saplings cut down, and the tap roots which were often of great length were also much shortened. The roots were packed in three boxes with dry leaves, a process which facilitated transport but demanded an extraordinary amount of attention. Shortly after my first arrival I collected a few plants which, with some stout pieces of the stems of saplings cut into lengths, I planted to experiment with. The greater number prospered wonderfully, and some natives were surprised at the quickness of the result. I put the most advanced of these plants into a small box, and although some lost a few leaves yet I brought the best portion home alive. Thus I saved sufficient plants from this little collection for the formation of stock for the plantations in India.

Methods of collecting rubber practised by the natives on the Isthmus of Darien and other places.—One of the oldest rubber collectors of the district where the plants were procured assured me, that at first they sometimes met with a tree at which three or four axemen could go to work at once to cut down. Such a tree would probably be about 8 feet in diameter, 200 feet in height, and yield at least 150 pounds of India-rubber. In

general full-grown trees do not much exceed 160 to 180 feet, with a diameter of five feet, and a produce of 100 pounds of rubber. The bark of the trunk is thicker than that of most trees of the same dimensions. The wood is spongy and soft, and decays rapidly wherever injured. The slender branchlets that crown the trunk terminate with four or five large leaves alternately arranged and thickly covered with short brown hairs. Many of the leaves measure 14 inches in length and seven inches in breadth, and exceed in size those of any other tree of tropical America. According to the natives, the leaves fall off the trees in January, after which they begin to flower. In April the new leaves push, and attain their full size in May. But I was assured that young plants and saplings retained their leaves throughout the year. The milk-like juice of the tree, which, when congealed, forms India-rubber, is obtained by cutting out a groove or ring of bark around the base of the trunk. The milk exudes from the bark into the channel thus formed, and large leaves are placed so as to receive it as it trickles down. The tree is then felled, and rings or channels are cut out around the prostrate trunk, at about 12 or 14 inches apart. Beneath these leaves or vessels are placed into which the milk flows. The contents of all the vessels are afterwards put in a hole previously dug in the ground. The milk left in this way becomes curdled in about two weeks. In the Republic of Ecuador most collectors use the soft green stem of a climber—a species of *Ipomea*—which when bruised and stirred about in the milk congeals it in a few minutes. By this last process the milk takes up all the watery particles it may contain and the produce seemed to be of an inferior kind, possessing a strong peculiar smell, and continually sweating a black ink-like water. Soap is resorted to by some collectors, and also wood ashes which contain potash. Collins mentions that alum is used in Brazil and salt in the East. It seems to me that whatever method is adopted the rubber ought to be prepared *rapidly and to be perfectly dry and free from impurities.* Powerful presses might no doubt expel the moisture, but I should expect that the goodness of the article would by this operation be depreciated. My own opinion is that the quality of the milk-like rubber juice obtained from various

species of plants—some of which are climbers and shrubs while others become large trees—is at first exactly the same, and that the difference in value of various parcels is explained by a different mode of preparation. The collectors indeed always aim to keep it as wet as possible as it is bought by weight. At Nicaragua and some other places of Central America the trees are not usually felled. The practice is to cut winding channels in the bark leading to the base of the trunk, where the milk is collected. But I was informed by an intelligent person from that region that this operation is so rudely and carelessly performed that a tree invariably dies after it has been bled or tapped a second or third time. This would never take place if the thin filmy lining of the inner bark (*cambium*) which covers the wood was not bruised or injured.*

Not only do the natives cut through the *cambium*, but they also make large notches in the living wood of the tree, and these under no possible class of circumstances or conditions can ever be healed. In collecting the milk the *cambium* need not be hurt, as the vessels which contain it really occur in the middle of the bark. Such at least is the case with the Darien rubber tree. The employment of any simple implement so formed as to make a groove in the bark to about one-half its thickness, is all that is required. Such an operation would require to be directed by an intelligent, careful person, who thoroughly understood how much success depends on the proper performance of the work. In this way not one single tree in a thousand would be lost and the trees might, in my opinion, be operated on annually, instead of once in three years, which I have been informed is the practice at Nicaragua. Dr. Macdowell, a gentleman connected with the *Star and Herald* of Panama, whose practical and scientific articles would well compare with those of the best-conducted English journals, has repeatedly called attention to the reckless and destructive methods employed in collecting the vegetable products which grow spontaneously in the forests of Central and South America. However, too little notice has

* Experience with the Ficus elasticabas raised serious suspicions with us, that the trees will die, if tapped repeatedly, whether the operation is performed carelessly or not.—THE EDITOR.

been taken of his observations either by the State or Municipal Governments. I have noticed during my travels that in the process of collecting the wild products of the forests there is often much wasted by the natives.

Climatic conditions of the India-rubber regions.—The temperature of the forests in the interior of the Isthmus ranged from 75° to 88° Fahrenheit. Frequently I have observed the thermometer standing at 80° at eleven o'clock at night, and the same on various occasions at one and two o'clock in the morning. When there occurred a shower of rain accompanied by a north wind the thermometer went down to 74° for one or two hours; but this was the lowest point to which it fell. I have not been able to ascertain to what altitude the tree grows as no high hills exist on the Isthmus, but I am pretty confident from observations made while travelling on the Pacific coast, that it ascends at most to an elevation of about 1,500 feet. At this height the lowest temperature experienced at any time throughout the year would be 62° or 60° Fahrenheit. As regards moisture, I happen to have lived and travelled in various rubber districts, where the rainfall varied considerably. On the Pacific coast, the tree grows near the Gulf of Guayquil on flat or gently sloping land, in deep deposits of a very sandy loam. The vegetation is moistened by humid fogs, but showers of rain very rarely occur. On the whole the atmosphere is unusually dry.

At Esmeraldas the soil is a heavy loam or clay. There is about five months of dry or summer weather and the remaining months are rainy.

In the neighbourhood of Buenaventura the tree is found dispersed over a broken and dislocated region of narrow ridges of nearly naked conglomerate with steep shelving ravines more than a 1,000 feet in depth. Where there is soil it is loam or a kind of clay, or made up of vast heaps of decomposing *debris*. The rains here are almost unceasing, day and night, throughout the year. This part of the coast, and on as far as the river San Juan, has been considered by intelligent travellers as the most unhealthy tract of country in the world.

The region proper of the Isthmus of Darien lying farther northward and including Portobello, Colon, Chagres, and Panama, is very wet, with an excessively damp atmosphere, although the weather is generally better, with some sunshine, during the months of January, February, March and April. The deposit of the low flat hills is more or less of a clay character, but along the banks of streams or rivers the deposit is mostly of rich but deep sandy loam.

Many of the localities bordering on the Magdalena possess deep beds of sand and loam resting on a stratum of yellow gravel. The climate is often parched and dry. Rain falls in May, June, July, and August.

It will thus be seen that this rubber-producing tree is subjected to a variety of climatic conditions which might have been expected from the wide extent of country over which the species extends. These circumstances appear to me to present a favourable prospect for its successful cultivation in India.

The Indians of the Isthmus of Darien and the Andes.—There were few Indians in the forests where I was engaged, but some families are still scattered along the banks of the Rio Trinidad. The remains of an independent tribe lived in a locality about six hours journey north of La Providencia. There were some large rubber trees at the place, and a collector, whom I knew, asked liberty of the Indians to enter the district, but was refused. From further information it would appear that these, as well as the San Blas Indians, a warlike tribe inhabiting the region to the south and west of Portobello, are not very safe people to be among.

Different, however, is the character of some of the remnants of the old Indian tribes of the Andes. I have travelled in these regions for thirteen years, nine years of which I have lived with Indian tribes and communities. Among these Indians I saw many excellent examples of kindness, frugality, modesty, propriety, honesty, and humanity. While with them I first began to learn and comprehend the value of those grand but simple principles, which, when properly directed and administered, bind a tribe or a nation together and form the *razon* and the science of government. Unencumbered by useless trap-

pings and formalities—which waste time and produce diseases—and unbiassed by the hideous ferocity of religions—these Indians have lived for many thousands of years without creating among themselves victims of insanity or a long category of nervous and epidemic debilities. I found no cases of insanity amongst the Indians.

Traces of Ancient Indian places of habitation.—In the search for India-rubber plants a large flat Indian mound was discovered surrounded by thick forest. The soil on examination was found to contain many fragments of pottery

Everywhere in these forests traces of ancient towns and habitations are to be met with.

Farther to the southward in the region of the Andes exist proofs of a more extensive character of human occupation. In the hot littoral districts and banks of rivers, as well as in the dense lofty forests of the slopes, and up even to the towering brows of the *paramos*, we find a marvellous abundance of pottery and stone implements, together with burial mounds and deserted, overgrown sites, the remains of extensive *poblaciones* long since passed away. The numerous ruins of aqueducts, causeways, roads, and temples shew that those nations had attained to a comparatively high degree of rational and useful civilization.

Return journey—wreck of the "Shannon," and arrival in England.—On the 2nd of September I reached the Panama line of railway and went on with the collection of plants to Colon. The negro population, both at this place and at Panama, are an insubordinate class of people. Passengers are often insulted and robbed by them, and even the chief managers of the railroad have been menaced in the most outrageous manner

On the 6th, I embarked on board the Royal Mail Steamer "Shannon," which was destined for Southampton. Few passengers went on board at Colon, but Mr. Wehner, a Manchester merchant, and others came with the ship from Savanilla The Captain shortly after leaving Colon fell ill, but all seemed to go on well until about 4 o'clock of the morning of the 8th, when the ship, which was running at the rate of 13½ knots per hour, struck on the "Pedro bank," a reef of rocks off the coast of

Jamaica and about 80 miles from Kingston. At the time of the accident I was lying awake in a cabin in the fore saloon, when I felt the ship go scratching over an object and almost immediately after she struck—the blow sounding like a stupendous explosion. I knew something serious was wrong. It was as yet dark, but not very dark, the atmosphere was quite clear without fogs or watery exhalations, and the weather was calm and uncommonly fine. Day soon began to break, and a low reef was apparent about half a mile distant from the ship over which the white surf was breaking. The position of the ship was now ascertained. She had gone right over a reef—which she only grazed—and struck on another with such force that her bow went up nearly four feet out of the water. The ship had in fact gone into the middle of a shoal of rocks—and her situation was in reality a sad one. The Captain, however, made every possible endeavour to save her. At 8 A.M. a boat was sent to Kingston for assistance. On the 9th cargo was got up and thrown overboard and the engines backed—but although the ship seemed lightened, she subsequently swung round on the rocks which surrounded her. The "Shannon" was above 4,400 tons, and was built by Napier of Glasgow. Her fore part was immoveable, but the stern bumped and struck against one or other rock at least three times per minute. At times I counted nine blows in two minutes. Each shock produced a vibration like the concussion of a large steam hammer. From the time she struck at 4 A.M. of the 8th until 5 P.M. of the 10th, when I left her, this massive ship resisted *above* 10,000 shocks and still remained comparatively uninjured. I made a remark to Mr. Thomson, the first engineer, and his answer was "she is just as strong as iron could make her." The sea water around, for about a hundred yards, was quite white and thickened with the ground up coral rock, produced by the friction of the keel on the reef. On the night of the 9th I attempted to sleep on the platform at the wheel, but the shocks threatened to pitch me off and on to the deck with violence. I then went down to the fore saloon, and slept soundly for one or two hours, during which time the remaining passengers were congregated about the quarter deck. At daylight the ship began to make

a little water beneath where the engines were located. The boats were then lowered, and the passengers were dispatched, but I remained on board as I thought the ship would last until we got assistance. In about two hours later the British Man-of-War "Dryad" came in sight, picked up the boats and afterwards took off the mails and treasure. I left the wreck with a boat which came for luggage on which I succeeded in transferring the boxes containing the India-rubber plants.

Proceeding from Port Royal in a tender I reached Kingston about 2 A.M of the 11th. On landing we were beset by a number of negroes, some of whom would insist on dragging the luggage about, and in this way a fifth of the rubber plants were bruised or injured. After a detention of three days, we went on board the Company's Steamer "Nile." All regretted the loss of Captain Leeds who has always been popular with passengers. The steamer reached Southampton on the 2nd of October.

Growth of the plants.—On arriving at Kew with the plants I had every facility afforded me by Mr. Smith, the Curator of the Botanic Gardens, for getting them re-established. On being sorted out I found fully one half had been injured or dried up. The remaining plants were put in a proper place to make growths, but these at first pushed very slowly, as the season at which they arrived is the worst in the year for the development of most kinds of tropical plants. At this time also the temperature in the warmest hothouse in Great Britain is generally ten or fifteen degrees *below* the natural heat in the forests of the Isthmus of Darien. Besides this there is a diminished amount of light which is an item of importance. On the whole every thing considered I have thought myself extremely fortunate. The plants are now progressing perfectly satisfactorily and most have commenced to push vigorous shoots. The collection, in all, will fill two cases, and may be ready to travel any time after Christmas.

I might possibly have procured the plants at one-half the risk, expense and fatigue, but then I could not have properly become acquainted with the *habitat*, and other circumstances, which it is necessary to know in successfully cultivating the tree in India. Besides the tree can certainly be relied on as of

the best variety yielding the rubber of commerce of those regions.

I have seen a few plants of a different variety or species of *Castilloa* at Kew, and also at a London Nursery, but have not been able to learn from what region these have been obtained. The leaves are very long and narrow with not very prominent veins, and the plants, at least those at Kew, show a strong disposition to "head," an indication which I have nowhere seen in the India-rubber tree of the Darien Isthmus. A completely distinct species of tree, whence rubber is likewise obtained, was seen by me in a locality near the Gulf of Guayaquil. My attention was called to it by the native collectors, who spoke of the large size to which it grew. It has no branches, but simply pinnate leaves from three to five feet in length, which form a large tuft on the top of the trunk like a gigantic grass tree. It seemed to be circumscribed to a limited extent of country.

Cultivation of the tree in India.—So far as I have been able to judge it seems to me there is a good prospect of success in all the Southern regions of India, Burmah, the Malay Peninsula, and the Islands of Ceylon and Borneo.

I do not know if it would be advisable to try the tree any farther north than the latitude of Bombay where the temperature, according to Dr. Brandis, does not fall below 60° Fahrenheit. But in all the hottest regions of India to the southward, where the *lowest* temperature is not less than 65° or 70° and where the land is not swamp or marsh or subjected to regular inundations, the tree is likely to thrive. Although growing most freely in moist forests, yet it will probably be found to prosper well on low hills as well as sloping plains, if there is some moisture and soil sufficient to nourish a banyan or a jack tree. The hot moist more or less wooded regions extending from the base of the Neilgherry hills towards the Malabar Coast are, as far as I can remember, specially adapted for this species of India-rubber tree. It is very suitable for planting along the sides of river banks, canals, streams or water-courses.

The banks of the Ganges might be a fit place to plant groves of these trees. But now a person has informed me that the

temperature at Calcutta has been known to fall as low as 45° Fahrenheit. I would not say that the tree would suffer from so low a temperature which of course would only be temporary, but probably it has not been subjected to such in its native country. Dr. Brandis gives the lowest temperature of Calcutta at 49°. I have wearied myself in looking for satisfactory information regarding the *lowest* temperature of many regions in India. This vital point, so useful for many things and purposes, seems to have been much overlooked. The "maximum" or "mean" records are of little importance—the essential point is to ascertain the *lowest* temperature which may have occurred in any district.

Although the tree will probably prove remunerative, even if planted in gardens or on the banks of rivers, yet it is likely to prove much more so when cultivated in large plantations containing several thousands of trees. The propagation is easy; green shoots and pieces of the branches or mature stem about a foot long with a bud at the top root very quickly, if put into the soil soon after being taken from the tree. The tree may be permanently planted out by merely turning over a spadeful of soil or by loosening and cleaning about a square foot of earth. No doubt the employment, when planting, of a little wood ashes, burned earth or decayed leaves would prove beneficial. *In this and all other operations of forest planting, when the development of the trunk is desired, I would always give the plants an opportunity of forming tap roots.* But whatever method is found most expedient, the formation of plantations cannot be expensive. The tree grows so rapidly that, once it is above the usual growth of weeds and shrubs, it is not likely to be overtopped.

The natives told me that in about four years young plants grew up to be trees. However, I think six years might be allowed for the developement of a tree 16 or 18 inches in diameter. The produce of such a tree would then be 25 pounds. For a tree of this species 18 inches in diameter Collins gives a yield of 50 pounds of India-rubber. As a tree becomes older its produce would increase, but taking a plantation generally it appears to me a safe calculation that each

tree on an average would produce 25 pounds of rubber per annum.

A fairly grown plantation six years old would be worth, at the lowest computation, £6 sterling per tree. I have made these remarks to shew that, if the tree succeeds, as I fully expect it will, no other tree or plant yet introduced into India will compare with it in the rapid and ample return it is likely to make to the planter.*

I have handed to Mr. Markham a specimen of prepared India-rubber and leaves of the tree, and have pointed out from a small map the chief districts visited by me in collecting.

In conclusion, I trust that this work, in so far as it has been performed, will merit the approval of the Secretary of State for India in Council and other Officers entrusted with the Government of India.

FULHAM, LONDON, *November* 1875.

The Special Survey Branch.

BY C. F. AMERY.

Some three or four years ago the Government recognised the desirability of appointing a special working plan branch in connection with the Forest Department. The heads of the Department had urged it upon the Government, who admitting the force of the arguments for the introduction of systematic operations under which the fellings of every year should bear definite and ascertained relation to the annual productive capabilities of the Forests, assented to the organisation of the special branch whose duty it would be to take stock of the Forests and frame working plans in accordance with their capabilities. But sanction having been accorded, it appears that it was then for the first time recognised, that of the very few men in the Department possessed of the requisite technical knowledge, hardly one could be spared from his present post; and, probably too, it occurred to the head of the Department that no amount of technical knowledge would enable an officer to

* On this point we shall do well to let actual experience in India speak.—THE EDITOR.

grapple fairly with the problem of supply and demand, and the fluctuations in demand which the rapid contraction of Forest area, especially of that in private hands, is likely to give rise to within a single rotation, and so the idea of a working plan branch was dropped, and a special survey branch substituted for it.

The survey of a Forest is the first essential preliminary to the framing of a working plan for it, and Captain Bailey on his appointment to the command of the party, having been instructed to survey the Dehra Doon Forests, and finding that there already existed a map of these Forests on the scale of half an inch to the mile, naturally concluded that this style of map fell short of what was required as a basis for working plans; and, apparently animated by a determination to make his maps all that they should be, procured a short leave of absence, visited the Forest Bureaus of France and Germany, saw the maps in vogue there, returned to this country and completed the survey of the Dehra Doon on the four inch scale, at a cost of one lac and twenty five thousand rupees. In round numbers, two hundred and fifty rupees per square mile.

I am far from wishing to find fault with these maps, or with the cost of the survey, which is probably the most perfect work of the kind that has ever been executed in India, on so large a scale. I am very far from wishing to find fault with the appointment of a special survey branch, which on the contrary I hold to be of first rate importance for those Forests which have not been surveyed, and which the Revenue Survey Department would probably not be able to take in hand for years to come; but, I am of opinion, that for Forests of which even approximately accurate maps on any scale exist, a new survey is not only not necessary, but absolutely useless in the present undefined state of Forest rights, and that for Forests which have not been surveyed, a survey on the four inch scale, excepting for plantations of a few thousand acres in extent, is simply waste of money. A survey on the one inch scale, with its several blocks enlarged to the four inch or eight inch scale by pentagraph, as convenience may demand, would amply

meet all the requirements of the Department for the next fifty years, and could be executed in a fourth of the time with a proportionate reduction in cost.

A Forest map to be of any value should be on sufficiently large a scale to admit of the representation of the general features o. the Forest, it is intended to illustrate. Anything beyond this is superfluous, and the error in basing our maps on the European model, originated in the assumption that our sytem of working could be immediately made approximate to the European system.

In Germany, maps on at least the four inch scale are indispensable—very few executive charges exceed five thousand acres, and even a forest of this size will sometimes be divided into two or three primary blocks, each of which is cut up into as many subdivisions as there are years in the period of rotation, especially in Forests worked by rotation of area. The data furnished to the central bureau embrace all the main features of each subdivision, age, class, and general condition of the standing crop, and it would hardly be possible to illustrate all these conditions on a scale of less than half an inch square for each subdivision. The supply too precisely equalling the demand, every tree can be cut out and sold at maturity, and the price of wood having a steady upward tendency and the rate of growth being accurately predetermined, the working plan aims at nothing short of forecasting the budget estimate for as much as twenty years-ahead, and to test the correctness of such estimates, first class maps on a large scale are absolutely indispensable. This differs widely from the conditions of forest administration in India. Here it is impossible to forecast the possible relation of supply to demand in the immediate coming future. There is no demand for any, but some half dozen of the most valuable timbers in the State Forests of India. The great bulk of our timber grows only to decay, thus supporting the view that we have more Forest area than we require, but year by year thousands of acres of Forest area give way to cultivation, the Timber sells for whatever it will fetch, the object of the owner being to clear his land, and these operations glut the market to such an extent, as to leave us no definite idea of what the demand upon our Forests will

be some twenty years hence, when other sources of supply are exhausted; and met by this difficulty at the outset, it is impossible to estimate rate of increment in Forests in which mature timber is passing to decay, or to determine the measure of demand in any given future period; hence, it is generally impossible in any but forests of first class timbers, to frame any but the most superficial and provisional working plan, based generally on the standing and prospective crop of such timber or other Forest products as are in present demand; and it is not likely that our system of working these for many years to come, will embrace their subdivision into areas so small, that their general features with all necessary information may not be adequately illustrated on maps with a scale of an inch to the mile.

Moreover reference has already been made to the unsettled condition of Forest rights, and whatever policy prevail, these will have to be adjusted in some form or other. The present policy appears to be to admit all claims and compromise them by giving up one part of the Forest for an absolute control of the remainder, and wherever this course is adopted fresh demarcations and surveys will be necessary, thus rendering the most perfect surveys incomplete. In fact such perfect surveys if not altogether useless for Forests liable to early and possibly to frequent modification of boundaries, are not of sufficiently practical value to justify the outlay incurred on them. All that is wanted in the present state of Forest management in India, is a tolerably correct map on the one inch scale, giving the boundaries and all important features such as watersheds streams, roads, &c., and guided by these natural or artificial subdivisions, stock might be taken as a basis for a preliminary working plan. Excepting in such cases as it may be proposed to frame separate working plans for areas not exceeding twenty thousand acres, the revenue survey maps on the scale of an inch to the mile are models of practical usefulness, and even for the small areas above indicated, it would not generally be desirable to incur the costs of a survey on a larger scale, unless the forest is untrammelled by rights which in their adjustment are likely to entail a rectification of boundary.

The difficulties in way of preparing such working plans for our Forests as it would be prudent to accept as safe-guides to the operations of the next century or even the next twenty years, are such as fairly justified the negation of the original proposition for the organisation of a special branch for their preparation; but it was quite possible with the means at command to collect data of infinitely more practical importance than the re-survey of Forests, of which fairly good maps already existed. Before all things—before even maps of any sort—we want correct estimates of standing stock in all those Forests of Teak, Sâl, Deodar, &c., the timber of which commands a ready market. Without such data the sanguine man annually fells double the quantity of timber his Forest is capable of yielding, while the cautious man felling as much below the mark maintains old timber, making no increment, to cumber the ground; the first course is fatal to all hopes of future revenue the second still more fatal, since it sacrifices the possible revenue both of the present and the future. Now without a survey, or maps of any kind, the valuation surveyor by accepting natural subdivisions, or cutting lines where no such natural subdivisions exist, could parcel out his forest and determine the stock on each block, and where and how much timber might be felled annually so as to utilise all the resources of the Forest without prejudice to their permanent maintenance. It is quite true that our imperfect knowledge of the rates of growth of our various valuable trees at their several stages may to some extent vitiate our calculations, but with a precise knowledge of the amount of stock at a given period, the recognition of our liability to err in our estimates of rate of growth, would soon enable us to check them.

Calculations deduced from the valuation surveys of lines or sample areas, are of little practical value, except for forest blocks on level ground uniformly stocked with trees of uniform size and age—what we want are complete valuation surveys, dealing with every standing tree of, say eighteen inches in girth, and upwards, and this could be thoroughly performed, and a vast amount of valuable data collected at a cost per square mile below that incurred for the Dehra Dun survey.

The most important factor in this operation and that entailing most labor is ascertaining the girth measurement of the trees at base, and this can be as well performed by a native writer on ten rupees a month aided by a chuprasy on five rupees, as by the most scientific European.

A party of twenty such couples, the writer armed with pen and ink at his girdle, and a book in his hand, and his assistant with measuring tape in one hand, to help in measuring, and a paint pot and brush in the other to mark the measured trees, would get over a considerable area in a day, chronicling the class and girth of every tree; while the officer in charge of the party, would take and register height measurements for age and class, and stock his note book with observations on the general condition of the block, soil, undergrowth, natural reproduction, &c., and should also be attended with a couple of coolies carrying a chain for the rough measurement of compact blocks of saplings below the minimum girths measured, and by the close of the valuation survey of a division. His intercourse with the divisional officer would have enabled him to collect such information as to demand, costs of transport, &c., as guided by his knowledge of amount of standing stock would enable him to frame general proposals for a working plan.

The majority of our trained assistants are perfectly competent to perform such a labor efficiently. It is not advocated that the proposals of the valuation surveyor should be acted on as a matter of course—both the divisional officer and his conservator being furnished with statements of stock, and estimate of rate of growth should be severally invited to submit independant proposals, and the Inspector General of Forests, with or without the assistance of one or more conservators taking these various proposals inot consideration, would be in a position to lay down a definite plan of operations which might be safely adhered to, for at least some years to come.

My observations and enquiries have furnished me with ample reason to believe, that if we could now get a valuation survey of the standing stock in State Forests as it existed ten years ago, some of our officers would be aghast at the dis-

covery of the extent to which the stock of those timbers most in demand has depreciated. The disappearance of such trees as Toon, Sissoo, Khair, Ghoosun—trees in great demand, but nowhere covering large areas is specially observable. The run upon them constitutes an important item of revenue for a few years, and officers being frequently transferred from division to division, their disappearance is unnoticed until the revenue from them ceases altogether. And this is not only the case with these trees of minor importance. The Deodar Forests of the British Punjab, supposed to be inexhaustible fifteen years ago, exist now only in memory, and the bulk of our Deodar is drawn from foreign territory, and there are grounds for believing that our standing stock of Sâl and Teak are undergoing unmarked, but steady depreciation.

I do not recommend "taking stock" as a panacea for all our difficulties—it will not reduce Forest rights to their legitimate dimensions, keep out fires, nor secure reproduction, but it will render it possible for us so to adjust our operations to the known capabilities of our Forests that there can be no further depreciation of any valuable stock without our recognising it, and enable us to determine in what cases it would be prudent to resort to artificial regeneration to balance the supply of any given class of timber against the demand.

When this has been done, when the Forests shall have been divided into blocks, and the stock in each block determined, when Forests rights shall have been made the subject of legislation intended to be final, when in fact our Forests shall be subject to no changes, save such as can be predetermined, a resurvey of them will be desirable; but, meantime, let us be content with such inexpensive surveys as are sufficient for our present needs, bearing in mind always, that the most costly surveys of to-day will be inadequate to our future requirements.

Lastly, I do not think it will be good policy to act on the present proposal to swell the Survey Branch by drafting trained Foresters into it. These men have been trained at some expense to the State—in their present positions they are acquiring a practical knowledge of Forest matters, which will enable

them to raise the present standard of Forest management: and to take them away from their own proper profession, for work for which professional surveyors are always available, appears to me to be a mistake. In France and Germany surveying is very properly made a part of a Forest officer's training. The smallness of his charge leaves him ample time for its exercise, in measuring up areas damaged by storms, &c., but in the large Forest charges of India it is not only not necessary that the Forest officer should be a surveyor, but I venture to say that every day spent by a Forest officer in (mere area) surveying, is a sacrifice of time that might have been devoted to more important objects, in the foremost rank of which I would place, valuation surveys of standing stock.

II. Reviews.

Hints on Arboriculture in the Panjab by Berthold Ribbentrop—1874.

Notes on Forestry by C. F. Amery—1875.

The recent appearance, both in India and in Europe, of several articles and pamphlets relating more or less to the work of the Forest Department in India is a noteworthy sign of the times and promises to bear good fruit in the immediate future. From the organisation of the Department more than 13 years ago until the publication in 1874 of Dr. Brandis' admirable Forest Flora of North-Western and Central India, our Forest literature consisted entirely of Official Reports, from the perusal of many of which, we confess, we rose without having added a single fact to our scant knowledge of the physical and economic conditions of Indian Forests. Latterly, it is true, every official document bristled with words of awful sound and pregnant meaning—*Working Plans, working by Rotation, Valuation of Stock, Capability, Normal Annual Yield, &c., &c.*, when we enquired what had been done to give these terms an objective as well as a subjective existence, we found that, with a few exceptions, they still floated about dimly in the limbo of speculation sighing, "till hope grew faint and turned to dark despair," for the moment of their delivery. In a word, we found, and we say this with feelings of shame and regret, that after an existence of more than 11 years, the Forest Department still stood undecided at the very point whence it started, forgetting its sacred but ungrateful mission and sacrificing to the Mammon Revenue the already exhausted resources bequeathed to it by centuries of waste and improvidence. But we forget that no one will thank us for these doleful reflections, into which, in spite of ourselves, we have fallen while examining the books now under review.

The first of these, under the very modest title of *Hints on Arboriculture in the Panjab*, contains a succinct *résumé* of the

general principles of sylviculture with some directions on the rearing of avenue and ornamental trees, followed by a special account of the principal indigenous trees of the Panjab. It forms only part of a more comprehensive work which the Author "intends to publish in the shape of Pamphlets for the use of untrained Forest Officers." The title of the book disarms all criticism, and we defer a detailed examination of it until the appearance of some more parts. But we cannot help regretting that Mr. Ribbentrop did not select a more ambitious plan for the present volume, and give us a fuller account of the various operations of Forest culture. For instance, many Sections of Chapter II on Natural Reproduction are very meagre and unsatisfactory, and might with advantage have been drawn out to three times their actual length. The inevitable consequence of the plan adopted is that the usefulness of the work is to a great extent marred by the uninviting style, which brevity of expression has forced upon the Author. Moreover the book exhibits signs of having been written in haste, otherwise such terms as "*preprations* of the soil" for "*methods of cultivating* the soil," "*coppices*" for "*coppice clumps*," "*productive* seeds" for "*fertile* seeds," and many others that we need not enumerate, would not have disfigured this very useful book.

We are also of opinion, although the majority of our readers will probably differ from us, that too much relative importance has been given to Artificial Reproduction. We believe that sylviculture in India is incompatible with sowing and planting, except in so far as they are the handmaidens of Natural Regeneration, or when new forests are to be created. To take two extreme instances, from the Panjab and the Central Provinces respectively. In the former Province the average cost of plantations has been, inclusive of salaries of Executive and Control Officers, about Rs. 30 per acre (irrigated land.) The rotation being 15 years, the outlay per acre at the time of exploitation would, at 5 per cent. compound interest, reach the high figure of Rs. 62. Say that the average yield per acre per annum will be 100 maunds (a very high figure) worth Rs. 8 standing. Deducting from this interest-

on Rs. 62, we have scarcely Rs. 5 left to pay cost of supervision and control, and upkeep operations and leave a margin for profits In the Central Provinces, where, when there is at all a brisk sale for fuel, the price of standing material is about Rs. 2 per 100 maunds, and where the yield from indigenous species is considerably smaller than in the Panjab, the gross returns would scarcely cover half the interest on outlay alone.

In spite of the defects we have indicated, Mr. Ribbentrop deserves the best thanks of all Forest Officers and those District and Public Works Officers who are entrusted with the management of Forests or the planting of roadside trees and groves, for having laid before them, for the first time in an English dress, rules of guidance, where previously all was haphazard and groping in the dark, depending on the whims and caprices of individuals.

If Mr. Ribbentrop's little book was urgently called for to supply, even to a partial extent, a long-felt want, it is, we admit, beyond the little ingenuity Nature has endowed us with, to discover the motive that has led to the publication of *Notes on Forestry*. This little octavo volume of 119 pages, of which 10 pages are occupied by the preface under the dignified title of Chapter I, is intended to "lay down general principles in such clear language that one who had never before given the subject (Forest Management) a thought might rise from its perusal with a good general idea of what to do and how to do it."

Chapters II—V and X—XIV are respectively devoted to Sowing, Planting, Thinning, Felling, Simple Coppice, Coppice with Standards, Selection-felling or *Jardinage*, High Forest and "Timber Forest with Coppice," subjects that are treated with infinitely more détail in the *Hints*. The only subjects touched upon by Mr. Amery, which the last-mentioned work passes over in silence, are Timber-transport, Measurement of Timber. "Taking Stock," Working Plans, "Period of Felling" (Exploitabilité) and Conversion into High Forest. But here again Mr. Ribbentrop in the Conference Report of 1872 and in his Working Plans of several Panjab Forests, Dr. Brandis

In his various Official Writings on Working Plans, Hoppus in his Tables, Captain Walker in the Reports on Forest Management published by the India Office, besides the numerous papers on the slides and tramways constructed in Bombay and North-Western India, afford 10 times more information on the first four subjects, than the fleshless and very incomplete skeletons supplied by Mr. Amery. Conversion into High Forest and the considerations that regulate the various ages at which a forest might be cut with greatest advantage to the proprietor (pithily termed *exploitabilité* by the French) are broached for the first time in a publication meant for India, but these are subjects that require each of them as many pages as the whole pamphlet before us contains in order to be treated in an elementary though full manner. Having glanced over the range of subjects Mr. Amery attempts to deal with, we will now trouble our readers with some remarks on the value of the information he gives.

On page 14 he says that "such is the rapid growth of some of our trees in their earlier stages, that it will probably not be desirable to extend the period (between the first regeneration or seed-cutting and the final or clear-cutting) beyond two or three years!" We suspect Mr. Amery judges of the growth of self-sown seedlings from his experience of nursery plants, or perhaps he has in view the fabulous growth of the *Casuarina equisetifolia* reported from the Madras Presidency, which however is still an exotic. To take one of the most favorable instances, that of Teak, we know that artificially raised seedlings attain a height of from 15′ to 35′ with a girth of from 5″ to 13″ in the first three years, the average being about 19′ with a girth of 7″; whereas the average height of a natural seedling of the same age is, if we are not mistaken, scarcely 8′ in Burma and on the Western Coast of India, and seldom exceeds 3′ in the Central Provinces, with a proportionately diminished girth. The early growth of Sâl bears no comparison for rapidity with Teak, and the same is true for nearly all, if not all the species that are the natural companions of Teak and Sâl. It is evident then that, even under the impossible suppo-

sition that a full crop would come up the very year of the primary cutting, Mr. Amery's figure is *by far* too low.

Again on page 15, the plan recommended for substituting "another class (*sic*) of tree for that now growing in the forest" is opposed to all experience. It can never succeed unless the new species is better adapted for the locality than the standing one, and the very fact that the latter actually occupies the ground is *primâ facie* against such a supposition. In Europe where the oak has disappeared by the encroachment of the beech, the process of reintroducing the former is by no means found so easy and economical a matter as Mr. Amery makes it out to be. The same over-riding of experience pervades the last paragraph of page 16, turn up the sods as thick as you like, the ground will cover itself with grass of stronger growth than the seedlings, except in temperate climates where the grass is naturally low.

On page 19 Mr. Amery states, that the Sâl seed germinates on the parent tree, and yet he says immediately after that it may be kept for "a few weeks spread out on sand in a shady place and well sprinkled with water twice a day." Is it possible to reconcile these two statements? Now it is a well-known fact that the Sâl seedling, including the developed radicle and plumule, attains a length of more than 6″ as soon as germination is over. Can plants of this size be kept spread out on sand with the air playing all round them for several weeks? The fact is that though many seeds *do begin* to germinate before they fall, the majority do *not*, and we are personally acquainted with at least one case in which the seeds stood a transport of several days without any special precautions, such as watering, &c. The statement on page 20 respecting Teak seeds is also too general, there being frequent cases to the contrary.

Passing over other *slips* of this kind we will turn over to page 36, where directions are given relative to the method of growing large trees of species that are too light-loving to prosper in close plantations (*i. e.*, forming a leafy canopy overhead). "Thinning out should be resorted to directly their branches

come into contact with each other, and when the forest has attained the required height, the thinning should be so sharp as to leave every tree standing alone." Now in the first place, if a species requires such severe thinnings, individuals of it will never close in with their crowns, and conversely if the individuals join their crowns, they do not require such a "sharp" thinning; and in the second place, if the trees are to be isolated at such an early age as that at which, especially in this country, they attain the "required height," what ought to be done to prevent the "forest floor" from degenerating into rank grass lands? The broad general rule to follow in dealing with such species is to thin *frequently* without ever breaking the leaf canopy overhead, but gradually increasing the thinnings in severity, and never to grow them pure but in company with shade-loving trees, which do not attain the same height as themselves, and which, therefore, while protecting the forest floor and drawing them up, leave the greater part of their crowns free.

Not to exercise our readers' patience too far, we will now pass on to Chapter VII., page 55, on the measurement of timber. We fail to perceive the utility of the diagrams on page 58 with the accompanying word—description It would require no more knowledge of mathematics than Mr. Amery grants in his readers to take at once a cone and show the inaccuracy of the practice of taking the mean diameter of round logs at the middle. Clearness is in no wise aided by redundant words and diagrams. But this is only a venial defect of the Chapter in question. There is some most extraordinary blundering in the arithmetical illustrations, which we would fain, for Mr. Amery's sake, attribute to the printer, but that its occurrence is too general to admit of such a supposition. For instance:—

$$\frac{12^2+6^2+12\times6\times25\times0\cdot7851}{3\times144}=3\cdot69$$

and not 11·15, which, however, is the correct result obtained by writing the above, thus:—

$$\frac{(12^2+6^2+12\times6)\ 0\cdot7851\times25^1}{3\times144}$$

Again the arithmetical processes on page 60 are incomprehensible; they ought to have been written as follows :—

$$\frac{1}{144}\left(9^2+\frac{12-6}{12}\right)0{\cdot}7854\times 25=11{\cdot}45,$$

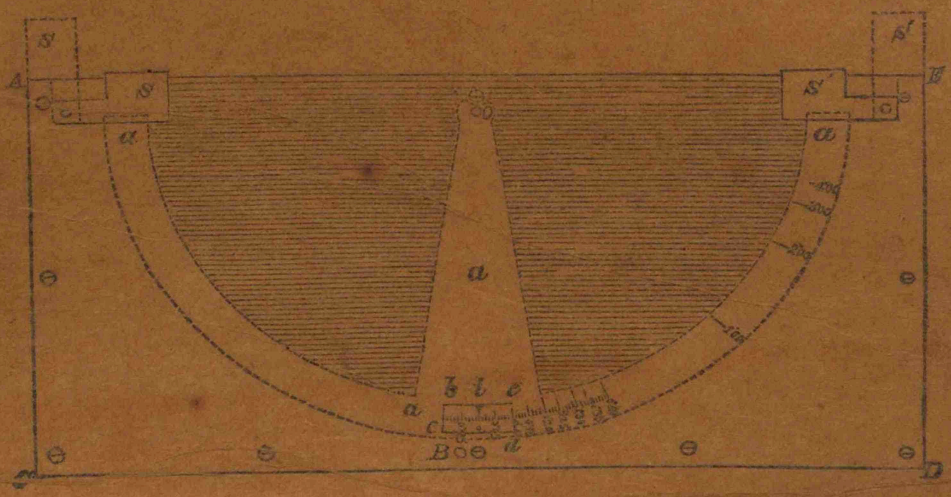
$$\frac{1}{144}\left(\frac{12^2+6^2}{2}-\frac{6^2}{6}\right)0{\cdot}7854\times 25=11{\cdot}45,$$

$$\text{nd}\ \frac{1}{144}\left(9^2+\tfrac{1}{3}\times\frac{12^2+6^2}{2}\right)0{\cdot}7854\times 25=11{\cdot}45.$$

The hypsometer, or dendrometer, figured on page 62, is one of the most awkward to use, as well as to carry about that can be imagined. In the first place dividing the sides of the square board into 10 equal parts is not sufficient, for if each part is to represent 10 feet, then there must be smaller sub-divisions to represent every two feet if not every foot, otherwise it would be impossible to read within three and even four feet of the correct height, and this all the more the greater the divergence of the line of sight from the horizontal. In the second place, in a hilly country, it is seldom possible to choose a convenient position, and the observer may thus be obliged to station himself a good deal above or below the horizontal line passing through the base of the tree; in such a case he would be obliged to shift the plumb line from *E* to *D*. In the third place, what is to be done when the ground is too rocky to allow of the "stock" being fixed firmly in position? We could multiply the defects of this instrument, but they will be obvious to any one. We will not say anything about Mr. Amery's expression of a "line intersecting a point," but describe the dendrometer of M. Bouvart, which is the best we have ever seen, and which does not appear to be known to the generality of Indian readers.

A C D E represents two thin boards firmly riveted or screwed together at their edges, and hollowed out (*vide* shaded part) so as to receive between them a graduated brass arc, *a a a a*, oscillating freely round its centre *O*; *b c d e* is a rectangular opening in the upper board, through which the graduations of the arc are seen; *i* is an index to read off the graduations with, coinciding with zero when the line of sight is horizontal; *B* is a button which, on being pressed, sets free the gra-

duated arc, which is otherwise stopped by a spring; *S S'* are



brass sights represented, folded down and put up when in use, *S* containing the pinhole, *S'* a larger opening with a hair stretched across it horizontally. It is evident that the height of a tree is equal to the product of the distance of the observer from its base and the tangent of the angle of elevation. If the instrument gave degrees and parts of a degree, the use of mathematical tables would be indispensable; but the arc is so graduated that each graduation gives the tangent itself of the corresponding angle of elevation. The graduations rise both right and left by hundredths, thus 0·00, 0·01, 0·02, &c. The reason for graduating both legs of the arc is, that when the eye of the observer is not in the same horizontal plane as the base of the tree, he directs the instrument both on the base as well as the top of the tree, and takes the sum or difference of the two readings for the required factor according as his eye is above, or below, that horizontal plane. The demonstration of this is evident to any one acquainted with the mere elements of Plane Trigonometry.

We will pass over without remark Chapters VIII. and IX., though the temptation to say something is almost irresistible. With regard to Chapter X. it will suffice to say that the decay of the stool is no disadvantage in coppice. If the stools have been cut low enough for the shoots to spring up from near the

ground (and in the case of the *Ber* many will come up from below the ground), the shoots soon develop their own roots, and the stools invariably die at length by atrophy of their roots, but the shoots themselves yield the stools of the next following exploitation. Hence is explained the indefinite duration of forests worked from time immemorial as simple coppice without any aid from artificial reproduction.

In Chapter XI., page 84, the extraordinary statement is made that in coppice with standards you can "*never* obtain timber." We ourselves have seen forests of mixed oak and beech with *numerous* standards, in which the average length of bole of these latter was scarcely inferior to what would have been produced in a high forest, and it is a patent fact that oak coppice standards supply no inconsiderable portion of the timber used in the French dockyards. From this it will be evident that the German Forest Officers, with whom Mr. Amery came into contact, had generalised from insufficient data when they concluded that "leaving more stems at every felling than was consistent with the ideal theory of a mixed forest" was the cause of the unsatisfactory state of the forests referred to.* In fact by carrying this system a step farther, you obtain in a short time a forest which the unpractised eye would easily mistake for a regular high forest.

In Chapter XII. an equally extraordinary statement is made that the Plaenterbetrieb system, in the final period, affords light-loving trees that free space which they cannot get in "close forests," by which we suppose Mr. Amery means regular high forest; on the contrary this latter system by localising the age, groups is much more favorable for graduating the quantity of light to the requirements of every tree.

On pages 103 to 105 is sketched out an instance "sufficient to indicate the general principles" of transformation of a forest worked by *jardinage* into a regular high forest. But our author, as is usual with him when figures occur, gets into a

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* We fear Mr. Amery must have made some mistake, at any rate we never heard of the theory here propounded. Muhafiz-i-jangal, too, ought to have known that German Forest Officers are not likely to approve of what is probably Mr. Amery's theory only. We ourselves are not in favor of coppice with standards, except in cases where the area is so small, that high forest and coppice can not be adopted on separate blocks.—THE EDITOR.

hopeless confusion respecting the ages of the trees, and the example is so unhappily chosen, that to the uninitiated it would appear that two long rotations were generally required in each case of transformation. At the end of the second period the age of the trees in Blocks C and B, would range from 81 to 110 years, and in A from 56 to 115 years; but Mr. Amery makes out 61 to 120 and 1 to 80 respectively; hence in the fourth period the last trees felled in C would be all above 100 years old, but Mr. Amery says from 75 to 80 years. Again in the fifth period the trees in B would be cleared out at from 121 to 160 years of age, and in the sixth period those in A would be cleared at from 116 to 155 years, but Mr. Amery's figures are 95 to 100 years in the former case, and 75 to 120 in the latter.

We ourselves would have preferred regularising the whole forest by the end of the first 120 years, and this without requiring any more labor or expenditure than Mr. Amery's plan, and without running the risk of cutting our trees when decay had already set in (we have seen that although Mr. Amery takes the age of maturity at 100 years, he allows a considerable portion of his timber to remain standing till their 160th year).

To sum up, Mr. Amery has told us nothing new, but what we might have learnt in a much more satisfactory manner from sources available to every one, and the little he has told us, by no means gives us "a good general idea of what to do, and how to do it." As for ourselves we confess that after having during several successive years plodded through no inconsiderable portion of what the great European masters have taught and written, and after some years of experience in India, we cannot say that we have yet gained "a good general idea of what to do, and how to do it;" nor has a single one of our difficulties been at all smoothed for us by the 119 small octavo pages from Mr. Amery's too facile pen. We give it as our opinion, unbiassed by personal feelings of any kind, that these notes should never have quitted Mr. Amery's private note-book, but remained there in company with the others that he may have taken for his own profit during his few months tour in Germany; but the world

might in that case have been deprived of the extraordinary picture (*vide* cover) of an European *shikari* riding placidly his elephant down a steep, narrow lane close planted on each side with thin, tall, liane-like stems forming a shady arched roof overhead, and a tiger only two paces off amusing himself and the shikari by doing the unusual feat of twining his body round one of the said stems, and "looking round the corner."

MUHAFIZ-I-JANGAL.

The above was received by us when we had just commenced ourselves a review of Mr. Amery's "Notes on Forestry." Although we do not agree with Mahafiz-i-jangal in all details, we could not refuse to publish his review, since we agree with him, that publications like these "Notes on Forestry" should be subjected to a powerful criticism, lest it might be understood that we approve of them.

Our personal friend Mr. Amery has shown, and indeed so again in this present number of the Forester, that he possesses a great power of argument. His "Notes on Forestry" prove that he has taken great trouble to become acquainted with the principles of forestry, but that is not sufficient "*to give others a good idea of what to do, and how to do it.*" Here his pretensions go beyond his achievement. No doubt the little book gives some idea of *what to do*, but it certainly does not teach the uninitiated *how to do it.* To do this, it is far too short, and written in too general terms. Moreover, there are many mistakes in the book. Some of these have been pointed out by Mahafiz-i-jangal, to whose list we could add many more items.

In the present state of Indian Forestry, we must not waste our time in attempting to write general handbooks on Forestry, for which we do not possess the necessary material, but we should confine ourselves to treatises on special subjects, which may be published in the shape of pamphlets, in periodicals, or in reports. After each subject has been fully treated and discussed in this manner, it will be time to proceed to a com-

pilation of the experiments made, the experience gained, and the rules to be deducted therefrom. Until that time arrives, we should advise Mr. Amery to confine himself to one subject only at the time, instead of attempting to grasp the whole at once, and we have no doubt he will contribute many a useful and valuable item to the general store of knowledge, by which forest management in India should be guided.

THE EDITOR.

REPLY *to T. K.'s Review of "The Indian Forester in France," at page* 46.

TO THE EDITOR OF THE "INDIAN FORESTER."

DEAR SIR,—As a general rule one would avoid criticising a critique; nevertheless the Reviewer, in his friendly notice of my little brochure on the Central Provinces Forests in the Journal pratique, makes one or two assertions about the Teak which by no means coincide with my experience, and which on that account I think I ought not to pass by in silence. I therefore trouble you with a few lines on the subject.

The reviewer observes that "the reproduction of Teak is only difficult as long as forest fires continue." It is needless to say that I agree with him if he means that unless forest fires are stopped, Teak conservancy is impossible, but it shows but a superficial acquaintance with the subject, if he thinks, as would seem to be the case, that when the forest fires have been stopped, the reproduction of a Teak Forest will go on with no further trouble and attention on the part of those who have charge of it. In the Boree forest of the Central Provinces, where fires have been put out for many years, it has been found that at least one hundred seedlings of Dalbergia and Pentaptera spring up for every one of teak. If nothing more were done, I believe the teak would soon disappear entirely, though it was originally the staple tree of the forest. Teak requires far more care than Oak, in a mixed forest of Oak and Beech, if its future is to be assured.

It certainly is not correct, in the Central Provinces at least, to say that as a rule the vegetation "of other species is *not more* active than that of Teak." The reviewer himself seems to be aware of this when he says, "that rank plants and jungle are apt to spring up and get the better of the Teak, and it first languishes, and then succumbs altogether." This is exactly my own experience, and what I thought I had expressed in my paper

But this part of the review is somewhat confused, and it is not quite clear if the reviewer is talking of Teak plantations formed artificially or of natural reproduction in the forests, where he says that Teak will not bear "cover over head" and that "it should not be *planted* where such exists." In the natural forest we have to deal always with cover over-head; and as to "planting Teak under cover," I never even heard it advocated.

My own idea (though I put it forward with deference) is that Teak seeds, from the hardness of the outer case, escape destruction by forest fires far more easily than many other species of seeds which are smaller and softer. Hence Teak has often been able to establish itself in almost pure forests (as in Boree, Aheree and other places) when other species have been unable to escape, and being killed off have made room for the Teak to grow. But it would be absurd on this account to advocate forest fires as being useful agents in Teak conservancy, though many persons, who ought to have known better, have no doubt by a similar strain of reasoning been led to do so. The study of the management of a mixed high timber and coppice forest, of Oak and Beech, in Europe, is probably as good a school as can be found for one to learn the way to deal with our Teak forests, at all events in the Central Provinces. The great tracts of Teak coppice in those Provinces might, I believe, be converted into high timber forests much on the same principle as is practised here.

On looking over my paper and the review of it together I see that I have written from a Central Provinces point of view, while my reviewer writes from a Birman one, *e.g.*, we are both right as to the season in which the Teak leaves wither and

fall as well as in some other minor details. But even in the Central Provinces this is by no means the same, for the season differs largely between the Baitool Hills and along the Godavery, and I accept the reviewer's correction.

The whole subject is one full of interest and most valuable in regard to Forest Conservancy.

It cannot be discussed too much, and we all know far too little about it, to venture to dogmatise when writing or talking of it. I for my part shall be only too ready to accept correction from any one who can show that his knowledge is obtained by practical experience, and not from theories, or a few hastily taken observations.

Yours faithfully,
G. F. PEARSON.

NANCY, *27th February* 1876.

III. Notes and Queries.

The financial results of the Forest Department under the Government of India (exclusive of Madras and Bombay) for 1871-75.

The following figures, exhibiting the above results, have been derived from a Resolution lately published by the Government of India:—

Name of Province.	Receipts.	Expenditure.	Surplus	Deficit.	Percentage of Surplus as compared with Receipts
	Rs.	Rs.	Rs.	Rs.	Per cent.
Bengal ...	1,85,933	99,403	86,530	...	47
North-Western Provinces ...	10,85,947	8,55,875	2,30,072	...	21
Punjab ...	8,34,874	6,16,180	1,88,394	...	23
Oudh ...	2,77,111	2,04,827	72,581	...	26
Central Provinces .	6,61,779	2,94,239	3,67,540	...	56
Burma ...	10,74,802	6,62,638	4,12,164	...	38
Coorg	58,012	37,999	20,013	...	34
Ajmere ...	203	26,566	...	26,363	...
Assam ...	64,749	59,523	5,226	...	8
Surveys ...	...	61,520	...	61,520	...
Total Rs. ...	42,43,710	29,49,070	12,94,640	...	*31

As regards receipts the several provinces rank as follows :—

(1) North-Western Provinces.
(2) Burma.
(3) Panjab.
(4) Central Provinces.
(5) Oudh.
(6) Bengal.
(7) Assam.
(8) Coorg.
(9) Ajmere.

As regards surplus they rank thus :—

(1) Burma.
(2) Central Provinces.
(3) North-Western Provinces.
(4) Panjab.
(5) Bengal.
(6) Oudh.
(7) Coorg.
(8) Assam.
(9) Ajmere.

Regarding the percentage of surplus as compared with receipts they range as follows :—

(1) Central Provinces.
(2) Bengal.
(3) Burma.
(4) Coorg.
(5) Oudh.
(6) Panjab.
(7) North-Western Provinces.
(8) Assam.
(9) Ajmere.

Thus it appears that on the whole the financial position of the Central Provinces is most satisfactory, and that in Bengal the proportion between receipts and surplus is next best, though the total receipts in that province are as yet small. Burma shows the largest surplus, which, however, does not appear to stand in proper proportion to the general receipts. The North-Western Provinces and the Panjab show large receipts, but a comparatively small surplus.

So far the general results as deductable from the Government Resolution. But it appears to us that the data given do not allow of a final judgment as to the merits of the results in the different provinces, and above all things, the forest area in each province, whence the revenue has been derived should always accompany statements of this kind. Besides, different modes of working are in force in different provinces. And again, in the Central Provinces for instance, the greater portion of the revenue is derived from forests which are not under the

control of the Department. In Burma several lacs of rupees are obtained by levying a toll on timber from foreign countries. In some provinces large sums are spent on reproductive measures, in others less is done in that direction. On the whole, therefore, the data exhibited are comparatively meaningless, beyond showing the actual receipts and expenditure. Hereafter it may perhaps be found possible to exhibit the financial results in a more elaborate manner.

We further learn from the resolution that the receipts and expenditure are made up as follows :—

RECEIPTS.

I.	Revenue from wood	31,59,095
II.	Revenue from minor produce ...	7,02,075
III.	Duty on produce of foreign or private forests imported in British Territory ...	2,35,937
IV.	Miscellaneous	1,46,603
	Total	42,43,710

EXPENDITURE.

A.—Conservancy and Works.—

I.	Cost of timber operations... ...	16,11,013
II.	Cost of minor produce	63,323
III.	Cost of forest organization ...	27,837
IV.	Cost of the treatment and creation of forests	1,57,531
V.	Rent of leased forests	42,508
VI.	Cost of collecting duty on produce of foreign or private forests imported into British India	1,381
VII.	Works of utility for the development of forests	97,068
VIII.	Cost of Departmental cattle ...	75,703
IX.	Cost of Departmental plant and tools ...	21,731
X.	Miscellaneous	22,235
	Total	21,20,330

B.—Establishment —

I.	Salaries	6,61,994
II.	Travelling allowances	1,23,434
III.	Contingencies	43 312
	Total	8,28,740
	Grand Total	29,49,070
	Surplus	12,84,640

Sw.

Notes on the effects of grazing on Sal forests in the Eastern Dooars.

After an inspection of the burned and half-ruined forests in the greater part of the Dooars, one is pleased and surprised, at the vigorous growth of Sal which is to be found in several blocks situated near some of the villages in the Sidli Dooar.

The trees are straight, with clean stems, and growing densely with little undergrowth, except a few low creepers, and Sal and other seedlings and low grass and ferns.

The absence of fires for several years can alone have caused such a good growth, and the burnt stumps in the ground attest that there have been fires at no very remote period. On enquiry from the villagers, it is stated that the village has been *in situ* for seven years, and that since that time the cattle have so grazed on, and trampled down, the jungle that there has been nothing to burn.

The cattle have not in any wise injured the Sal seedlings, which they do not eat, and the soil, being sandy and gravelly, has not been materially hardened, so as to affect its permeability for the nourishment of the roots of the trees.

These unburnt patches of Sal are of frequent occurrence in the Sidli Dooar, and the exemption from fire is everywhere due to the grazing, and to the presence of cattle.

In order to give an idea of the quantity of timber in these patches, I have measured off an acre in one of them, which is of considerable extent, 20 to 30 acres, and have counted all the trees on it.

Number of trees under 1½′ girth.	Number under 3′ and over 1½.	Number under 4½′ and over 3′.	Total No. per acre.
11	94	44	149

The above table gives the number of Sal trees on the acre, the girths being taken at 5 feet from the ground.

There was also one Kumbi—(*Careya arborea*), all the other trees being Sal.

The surface growth consisted of short grazed grass, ferns, and dead leaves, and seedlings of Bairu, Dudhkuri, Kumbi, Khoja, &c.

The measurement of the height of an average tree, girth 3′-6″, gave 52′ to the first branch, and 79′ to the summit.

The height is very uniform, of the trees over 3′ in girth. The soil is a coarse sandy loam, with grains of mica and quartz and pebbles of greenstone and quartzite. The rate of growth may be taken roughly to be 30 years, for a girth of 3 feet, but I have not yet counted the rate of growth of a sufficient number of trees to arrive at any reliable results.

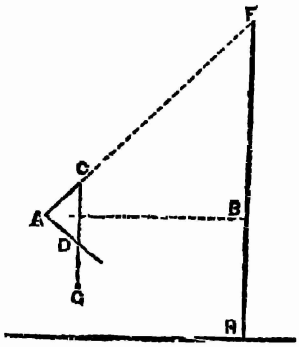
In conclusion, I believe that, when Sal forest occurs close to the boundaries of cultivated land, the presence of cattle along the edges of the forest will be a most efficient protection against fires, and therefore should be encouraged as much as possible, except in bare places which it is required entirely to restock.

W. R. F.

Fleischmann's Hypsometer.

As *G. F.* has received no answer to his query in the October number of the *Forester*, I send the following directions for making a Fleischmann's hypsometer:—

The two arms A C, A D, form a right angle at A. A plumb line is attached at the point C, one foot from A. The limb A D is two feet in length and divided into feet and decimals of a foot.



To use the instrument, align the arm A C with the top of the tree F, as shewn in the figure, and on A D read off the distance from A, at which the plumb-line C G cuts the arm A D. Measure the distance A B. Then,

$$A\,C : F\,B = A\,D : A\,B$$

and

$$F\,B = \frac{A\,B \times A\,C}{A\,D}$$

but as

$$A\,C = 1 \text{ foot.}$$

$$F\,B = \frac{A\,B}{A\,D} \text{ ft.}$$

The height above the ground of the observer's eye added to $\frac{A\,B}{A\,D}$ gives the height of the tree.

The *kluppe*, which is generally used for measuring the diameters of trees, can easily be made to serve also as a hypsometer; all that has to be done, is to attach a plumb line to one of the smaller arms at the required distance from its junction with a larger one.

JANGALI BULBUL.

Transplanting *versus* Direct Sowing of Teak.

I have been much interested in the replies to my enquiry regarding sowing and transplanting of Teak in other Provinces, and now give the information asked for by J. B.

Rainfall in Assam 70 to 120 inches, the rainy season begins first week in June and ends about the middle of October, but there are frequent storms and heavy showers in March and

April. I begin transplanting, if possible, in the middle of July, that means fill up vacancies, the seed having been sown at stakes a month previous, and do this as pointed out by J. B. for half the cost. For all this and in spite of the strictest economy in every other plantation work it costs Rs. 50 per acre at the least, and I envy J. M. being able to do the same work for Rs. 10, for, where this is possible, planting Teak might even at this early date of forestry in India, when funds available for such work are small, be carried out on considerable areas, whilst where plantations of Teak cost Rs 50 per acre, as in Assam, we shall have to be satisfied with having established some 60 or 80 acres for our successors to be guided by some 50 or 100 years hence, and defer more extensive planting until our natural forests have by care and protection recovered from former bad usage and excessive fellings, and give a surplus revenue which would justify more expensive improvements in the way of plantations.

G. M.

I have read J. B.'s note on "Transplanting *versus* Direct Sowing of Teak" at page 192 of the *Indian Forester* in the number issued in October 1875, and I notice that with about the same conditions, of climate, rainfall, soil, &c., as I have, he has been successful with Teak plants and his are all in a flourishing condition, while mine are small and very wretched specimens of plants. I should feel very much obliged to J. B. if he would let me know through this magazine, how he sows his Teak seed, how he prepares the soil, whether the seed he sows is old or new whether he steeps the seed or not, in short, everything connected with his method of sowing, so that I may see in what I have failed, and why I have not been as successful as he was.

H. G. B.

V. Shikar and Travel.

A Large Panther.

Khuber! How often has this magic word rejoiced the heart of many a sportsman, and caused the hot weather to be looked forward to even with pleasure by ardent votaries of the chase? And never was the writer of this more pleased to hear the word, than on a certain morning in the cold weather of 1875.

A large panther had long defied the united efforts of my best "Shikaries" to mark him down, whilst choice and dainty morsels in the shape of young buffaloes and goats had proved unavailing to tempt his appetite.

Many a night I had sat in a hole waiting for the brute, but he was too wary, and the country he hunted over too extensive to chance a beat, and so I had almost given up all hope of bringing him to bag.

On questioning "Kulladine," the most trustworthy and indefatigable of my men, he told me that the panther was lying in a small but dense belt of jungle at the foot of some huge cliffs skirting the river which flowed through my reserve.

I at once proceeded to the spot, and having surveyed the ground, climbed up a "Kowah" tree, and signalled for the beat to commence. The villagers, headed by my own men, screamed and "hanked" most capitally, whilst others thundered down huge rocks and stones from the top of the cliffs, causing the whole ravine to resound with the crashing and smashing of the grass and young trees,* as the stones tore through the underwood.

The beaters came up to within thirty yards of where I sat, but not a sign did the panther give of his presence! Back went the men to the commencement of the beat, and it

* This is hardly in accordance with forest conservancy.—The Editor

possible, "tomtommed" and yelled even louder than before; they had almost reached my position, when, by instinct alone—for the brute made no noise—I turned and saw the panther standing looking across the nullah! Although half hidden by the long grass I fired, and with a roar he bounded off and disappeared in the jungle.

On descending we found lots of blood, and "Kulladine" said that the panther was hit in the neck; knowing the splendid beast was wounded, how could I leave the warm and bloody tract? So slowly and carefully we walked into the high grass, which in many places was over our heads.

The blood was very plentiful and soon we proceeded at a sharp walk, though eagerly scrutinising every bush and likely hiding place. After twisting and turning for half a mile I all at once spotted the beast slowly walking on ahead and about to enter a small nullah. I instantly rushed to one side to cut him off, and on looking over the nullah saw my friend standing staring at me not more than ten yards off! I gave him little time to form my acquaintance, and brought him down with a steady shot through the shoulder. The plucky beast never uttered a groan, and after a few fruitless attempts to tear down a young teak tree his massive limbs quivered in the throes of death, and my prized foe lay dead at my feet!

Truly he was a gallant beast! Seven feet eleven inches from nose to tail, without any stretching, and exactly three feet in height. In fact he looked more like a tiger than a panther, and had a magnificent skin of a dark yellow hue and beautifully spotted. The skull was as large as that of a tigress and the claws of corresponding size. The body was very fat, and the best part of an undigested cow in his stomach accounted for the unwillingness with which he broke cover.

My first bullet had lodged in the throat, cutting some of the large veins, but not the jugular, and this accounted for the large quantities of blood.

The tracking was most exciting, as in more than one place the cunning brute had turned off to one side, and after proceeding in a half circle had come back to the old track, so if he had chosen to lie in ambush, we should have passed and

repassed quite close to him whilst following up the track and yet been unaware of his presence!

Such moments as these repay a man for the lonely weeks and months spent in the jungles, and cause a feeling of pleasure which is not easily effaced.

ADMIRAL.

V. Extracts from the Official Gazettes.

As we receive now the Gazettes of a few Provinces only, we cannot continue to give extracts as hitherto. We shall, therefore, instead give in every alternate number an extract from the "List of Officers in the Forest Department," published by the Government of India. The July number will contain those of the list which will be published during the present month.—The Editor.

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